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A project to educate parents on high school football concussion issues

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A PROJECT TO EDUCATE PARENTS ON HIGH SCHOOL FOOTBALL CONCUSSION ISSUES

A Project Report
Presented to
The Faculty of the Department of Human Performance
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In Partial Fulfillment
of the Requirements for the Degree
Master of Arts

by
Colleen Marie Chelini
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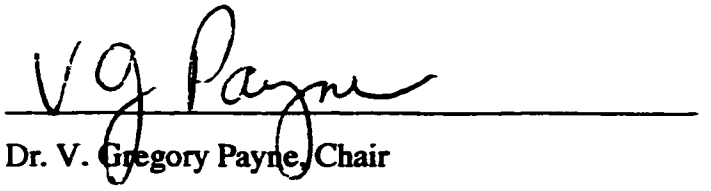
APPROVED FOR THE DEPARTMENT OF HUMAN PERFORMANCE



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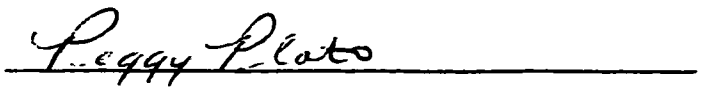

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ABSTRACT

A PROJECT TO EDUCATE PARENTS ON HIGH SCHOOL FOOTBALL CONCUSSION ISSUES

by Colleen Marie Chelini

This project involved creating a reference booklet and a presentation manual for schools to use to educate parents regarding concussions in high school football. The booklet and manual include general information on concussions, the role of mouthguards and football helmets in injury prevention, signs and symptoms of concussions, return-to-play guidelines, and liability issues.

The booklet and presentation manual were reviewed by professionals for quality and content. They indicated that the material was comprehensive, professional, and valuable for the high school setting The material was presented to the Redwood High School Pigskin Club to assess the educational value of this thesis project. The statistical analysis (t-test) of the pretests and posttests resulted in a significant difference, using a p value $< .05$. The results show this project appears to be of educational value.

Acknowledgments

I thank my project committee chair, Dr. V. Gregory Payne, for his diligence, expertise, and guidance throughout this thesis project and for allowing me to express my creativity. I also want to express my thanks to my committee members, Dr. Peggy Plato, for her attention to detail, and Dr. Leamor Kahanov, for her high caliber editorial content comments. My entire committee was responsible for the successful completion of my project.

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Lastly, I thank the Redwood High School Pigskin Club for providing an avenue for my project to be presented and assisting in its evaluation. I also thank Cecilia Frazer, secretary of the Pigskin Club, for helping me publicize the presentation to the high school parents.

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Chapter One

Introduction

In the United States, head trauma can be considered a major health problem with 130 to 150 people per 100,000 suffering head injuries annually (Mittl et al., 1994). A majority of head injuries, about 75%, are classified as mild concussions (Mittl et al., 1994). Currently, the Congress of Neurological Surgeons defines a concussion as "a clinical syndrome characterized by immediate and transient post-traumatic impairment of neural function owing to mechanical force" (Zachazewski, Magee, & Quillen, 1996. p. 402). A common definition of a concussion is, "a traumatically-induced alteration in mental status" (Zachazewski et al., 1996, p. 402). Although a patient recovering from a mild concussion will usually recuperate without incident, morbidity and mortality can be associated with concussions (Kelly et al., 1991).

Uncertainty exists regarding prevention of concussions and when an athlete can return to play. Football safety is extremely important because concussions can alter an athlete's functional capacities. A significant number of high school football players suffer from concussions annually (Gerberich, Priest, Boen, Straub, & Maxwell, 1983). Because of the current body of literature on cerebral concussions and their possible long-term effects, physicians have become more conservative and rely on their clinical observations to assess their patient's condition and the type of medical attention required (Cantu, 1986). Unfortunately, physicians are not present at all athletic practices and events leaving coaches, athletic trainers, and parents responsible for assessment and treatment of many injuries. This leaves them to assess concussions and when an athlete may need further medical attention. Because coaches and athletic trainers may not see high school athletes on a functional level outside of practice, the parents' role in understanding possible athletic injuries is extremely important.

Concussions have yield severe consequences including permanent neurological damage and death (Zachazewski et al., 1996). Proper use, fitting, and maintenance of football equipment are essential in maintaining safety on the field (McGuine & Nass, 1996). Mouthguards also reduce the severity of concussions by absorbing shock from blows to the head or chin (Chapman, 1993). Different positions on the football field put players at higher risks of sustaining a concussion (McKeag, Henderson, & McCoy, 1994). A player with a history of previous concussions may reduce future risk changing their position on the field. One important aspect of concussion prevention is education. Understanding the guidelines to follow after sustaining a concussion can reduce the risk of traumatic outcomes. Knowing reasonable guidelines for return to play can prevent further injury.

Parents are responsible for the health and care of their children and can play an important role in injury prevention when armed with the necessary information. Nevertheless, a national survey showed a lack of parental knowledge regarding brain injury risks in football (Goldhaber, 1993). Parents were questioned on their understanding of possible risks associated with playing football and their knowledge of warnings regarding football helmets. Each football helmet bears a warning label placed on the helmet by the manufacture informing users of dangers associated with using the helmet. The label warns that striking an opponent with the helmet could result in serious consequences such as brain or neck injuries, paralysis, or death. The warning label also states that no helmet can prevent all injuries. Goldhaber (1993) found less than 1% of parents were aware of the risk of severe brain damage associated with football, and only 36.9% of parents knew about the warning labels on helmets regarding the risk of severe brain damage.

Schools need to take a vested interest in educating parents on the risks related to football to protect themselves in liability lawsuits. Granger (1996) found that athletes and parents no longer accept accidents as unlucky. They feel someone should be blamed, whether it is the manufacturer, school, or coach. Lawsuits have been brought against schools alleging negligence of administrators and coaching staff. In Jarreau v Orleans Parish School Board, the coaches and school were sued for improperly assessing an injury and providing follow-up medical care (Heck, Weis, Gartland, & Weis, 1994). Some of the suits have cited failure to properly educate players on safety techniques, failure to educate participants and parents about risks associated with sports, failure to provide proper equipment, and failure to use proper care for athletic injuries (Heck et al., 1994). In Vendrell v School District No 26C, the school was sued for not properly informing the athlete of tackling technique, use of equipment, and dangers associated with participating in football (Heck et al., 1994). In high schools, providing educational opportunities for athletes and their parents will help improve safety on and off the field and protect the school from litigation (Granger, 1996; Heck et al., 1994).

Significance of the Problem

The National Operating Committee on Standards for Athletic Equipment (NOCSAE) states that head injuries account for 65% to 85% of all fatalities associated with football (Goldhaber, 1993). Each year an average of eight deaths occur in contact sports due to head injuries (Kelly et al., 1991). Physicians do not agree about when a player should return to play following a head injury (Bloom, 1998). Clinical findings are extremely important. Classification and return-to-play guidelines that physicians use may vary. A physician should evaluate an athlete before allowing the athlete to return to play. However, as seen in professional sports, athletes can sometimes find a physician who is willing to clear them (Bloom, 1998). But, is this in the best interest of the

athlete? The answer lies in the physician's findings (Cantu, 1998a). The discrepancy between treatments following initial injury and final results leaves athletes, coaches, parents, athletic trainers, and administrators in a state of confusion about when to allow an athlete to return to play. When dealing with the student athlete, one cannot be faulted for being too conservative. The results of a mistake can be catastrophic (Cantu, 1998a).

In high school football, parents play a significant role in decision making regarding an athlete's health. Although parents are instrumental in the decisions regarding their child's health, Goldhaber (1993) found parents were unaware of risks associated with playing football and misinformed about the safety of football helmets and their warning labels. There is a need for further education of parents regarding potential risks relating to football and head injuries (Cantu, 1998a, 1998b; Goldhaber, 1993).

Statement of the Purpose

The purpose of this project is to create an educational booklet and a presentation for schools to use to educate parents about risks associated with head injuries in football. Specifically, a booklet will be created for parents on concussions, prevention of concussions, general guidelines for helmet fitting, guidelines for concussion grading, and return-to-play criteria for athletes suffering from a concussion, and references for further reading and information. A manual will also be created for schools to use in presenting this information with the reference booklet. Parents will receive the information via an educational seminar, to be organized by high schools using a scripted manual. The seminar will help parents make educated decisions regarding their athletes' health and reduce the potential for school liability.

Project Hypothesis

The project will consist of two main components, the booklet and the presentation/manual that will be evaluated. The hypothesis for the booklet is that it will

increase the knowledge and education of its readers and serve as a reference tool. It is also hypothesized that the presentation, utilizing visuals aids, will further increase parents' knowledge on concussion issues in high school football.

Delimitations

This project is delimited to the following:

1. Parent reference booklet
    A. The reference materials will cover information on concussions, conservative guidelines for return to play, and the role of helmet fitting and mouthguards in the prevention of concussions for high school football players.
    B. The booklet will be of a reasonable length to fit within the attention span of the readers.
    C. Information will be presented at a level appropriate for the average parent.
2. School presentation and manual
    A. Information covered in the parent reference booklet will be included in the presentation manual.
    B. The presentation will be created using Power Point software
3. Evaluation procedure for the booklet
    A. Redwood High School parents unable to attend the presentation will evaluate the booklet.
    B. Two team physicians, three athletic trainers in high school settings, and two high school administrators will review the quality and content of booklet.
4. Evaluation procedure for the presentation and manual
    A. Parents from the Redwood High School Pigskin Club will complete pre and posttests to determine educational efficacy of the presentation.
    B. Quality and content of the presentation manual will be reviewed by two team

physicians, three athletic trainers in high school setting, and two high school administrators.

Limitations

The project will be limited by the following:

1. Parent reference booklet
    A. Material covered is not totally inclusive of all available guidelines on concussion grading and return-to-play criteria.
    B. Material does not cover injuries associated with the neck or spinal cord.
    C. Fitting of helmets and mouthguards will be general guidelines and not specific numbers.
2. School presentation and manual
    A. Due to time constraints and budget, the presentation will only be given at Redwood High School.
3. Evaluation procedure for the booklet
    A. The motivation level of parents reading the reference booklet cannot be controlled.
    B. Previous knowledge related to concussions and prevention cannot be controlled due to different backgrounds.
    C. The categorical responses on the pre and posttest do not allow for assessing the degree of knowledge of the subjects.
4. Evaluation procedure for the manual and presentation
    A. The motivation level of the parents during the presentation cannot be controlled.
    B. Previous knowledge related to concussions and prevention cannot be controlled due to different backgrounds.

C. The categorical responses on the pre and posttest do not allow for assessing the degree of knowledge of the subjects.

Definitions

Class I Evidence

"Evidence provided by one or more well-designed randomized controlled clinical trials" (Practice parameter, 1997, p. 584).

Class II Evidence

"Evidence provided by one or more well-designed clinical studies" (Practice parameter, 1997, p. 584).

Class III Evidence

"Evidence provided by expert opinion, non-randomized historical controls, or case reports" (Practice parameter, 1997, p. 584).

Catastrophe

"Any great and sudden calamity, disaster, or misfortune" (Friend et al., 1957. p. 230).

Catastrophic

"Of, like, or caused by a catastrophe; disastrous; calamitous" (Friend et al., 1957, p. 230).

Concussion

"Violent shaking or jarring action of the brain resulting in immediate or transient impairment of neurologic function" (Anderson & Hall, 1995, p. 688)

Direct fatality/injury

"Those fatalities (and injuries) that resulted from participation in the fundamental skills of the game" (Mueller, 1991, p. 114).

Guidelines

"Recommendations for patient management that identify a particular strategy or strategies that reflect moderate clinical certainty based on Class II evidence or consensus of Class III evidence" (Practice parameter, 1997, p. 585).

Indirect fatality/injury

"Those fatalities (and injuries) caused by systemic failure as a result of exertion while participating in football activity or by a complication resulting from a non-fatal injury" (Mueller, 1991, p. 114).

Morbidity

State of being "diseased; sickly; not sound and healthful" (Patterson & Litt, 1990, p. 220)

Mortality

"The nature of man, as having eventually to die; mortal nature" (Friend et al., 1957, p. 958)

Options

"Other strategies for patient management for which there is unclear clinical certainty based on inconclusive or conflicting evidence or opinion" (Practice parameter, 1997, p. 585).

Post-concussion syndrome

"Delayed condition characterized by persistent headaches, blurred vision, irritability, and inability to concentrate" (Anderson & Hall, 1995, p. 694).

Standards

"Generally accepted principles for patient management that reflect a high degree of certainty based on Class I evidence; or, when circumstances preclude randomized

clinical trials, overwhelming evidence of Class II studies that directly address the question" (Practice parameter, 1997, p. 584).

Summary

One in five high school football players will suffer a concussion annually (Gerberich et al., 1983). With such a high incidence of concussions, injury prevention is important. Traumatic outcomes and cumulative neurological effects of concussions can often be prevented (Kelly, 1996; Practice parameter, 1997). Educating parents about risks associated with football, how to recognize concussions, and the role of football helmets and mouthguards in injury prevention can help maintain the safety of their children on the playing field. Therefore, the purpose of this project is to create a program to educate parents. Presentation materials, including a brochure on concussions in football and a power point presentation, will be designed for high schools to use in presenting information on head injuries and prevention to parents.

Chapter Two

Review of Literature

The purpose of this project is to create a booklet and presentation manual for high schools to use to educate parents on the risks of concussions associated with football and the importance of injury prevention. In this chapter, literature concerning concussions, protective equipment, the importance of injury prevention in football, parents' knowledge of risks associated with participating in football, and liability issues for schools will be reviewed. This chapter will be divided into five different sections. The first section will give an overview of head injuries, focusing on concussions. The following section will focus on the role of protective equipment in the prevention of concussions. The next section will look at the need for parent education. The final section will briefly discuss liability issues for schools relating to athletic injury. The chapter will conclude with a brief summarization.

Head Injuries

"Head injury" is a generic term covering a wide range of injuries associated with the head. The term "head injury" can include skull fractures, cerebral hematomas, cerebral contusions, and concussions (Zachazewski et al., 1996).

Skull fractures are usually the result of tremendous focused force over a small area. They may be classified into four categories: linear, commuted, depressed, and basilar. The actual location of a fracture site may also vary. If the thickness of the skull is minimal, the fracture will usually occur at the site of impact. If the skull bone density is thick, the fracture site may occur at a nearby point where the skull is thinner and cannot handle the stress of the impact. A skull fracture should be immediately referred for a physician evaluation (Anderson & Hall, 1995).

Cerebral hematomas can be classified into two categories, epidural and subdural. Hematomas are a localized collection of blood. The classification of the hematoma depends on its location relative to the dura mater. If the blood pools outside of the dura mater, it is an epidural hematoma. If the blood pools within the dura mater, it is a subdural hematoma (Anderson & Hall, 1995; Zachazewski et al., 1996).

Epidural hematomas are extremely serious injuries requiring immediate medical treatment. If the hematoma is associated with a rupture of the meningeal artery, the hematoma will form relatively quickly due to the arterial pressure (Anderson & Hall, 1995). Although they account for 1% of all head injuries, epidural hematomas result in 5% to 15% of all fatal head injuries (Zachazewski et al., 1996). "However, even with early diagnosis and aggressive treatment, epidural hematomas carry a mortality rate of 8%" (Zachazewski et al., 1996, p. 400). Epidural hematomas are commonly associated with skull fractures. They are usually treated surgically to relieve intercranial pressure within the skull.

Subdural hematomas account for 26% to 63% of all serious head injuries (Zachazewski et al., 1996). Generally, subdural hematomas are associated with venous blood vessel lesions, resulting in slower bleeding and formation of the hematoma. This can lead to delayed onset on signs and symptoms (Anderson & Hall, 1995). Subdural hematomas can be classified as simple or complicated depending on the involvement of the brain tissue in the injury. "The mortality rate of complicated subdural hematomas is 53%" (Zachazewski et al., 1996, p. 402). If surgery is indicated, early diagnosis is key since the mortality rate is less than 40% if the surgery is performed within 4 hours. The mortality rate increases to 80% to 90% if surgical intervention is performed over 4 hours post injury (Zachazewski et al., 1996).

A cerebral contusion is a localized injury with bleeding being dispersed throughout the brain tissue. A cerebral contusion can "occur in any portion of the cortex, the brainstem, or the cerebellum" (Zachazewski et al., 1996, p. 402). Patients with cerebral contusions will present with varied signs and symptoms including unconsciousness, headaches, dizziness, and nausea. They should be evaluated clinically.

Concussions are an extremely common head injury. There are different classification guidelines regarding concussions used in conjunction with a physician's clinical findings. Significant literature can be found regarding concussions, the focus of the following literature review.

Overview of Concussions

There are a number of different diagnoses associated with concussions, including concussions and second-impact syndrome (Cantu, 1998a). The Congress of Neurological Surgeons defines a concussion as "a clinical syndrome characterized by immediate and transient post-traumatic impairment of neural function owing to mechanical force" (Zachazewski et al., 1996, p. 402). For simplicity reasons, a commonly used definition of a concussion is "a traumatically induced alteration in mental status" (Zachazewski et al., 1996, p. 402). Within the definition of a concussion, there are several different levels of injury classification. However, within the medical community, there is no agreement on one particular guideline for concussion classification or when a player can return to competition (Bloom, 1998; Cantu, 1998a).

Some physicians feel most guidelines are conservative and a good educational tool, but for physicians with substantial clinical experience with concussions, the guidelines are rarely followed. Physicians synthesize their experiences and knowledge to determine recommendations for their patients. There is also considerable debate as to whether brief loss of consciousness and posttraumatic amnesia should be symptoms

placed in the more or less severe category. Some physicians have expressed concerns regarding the possibility of guidelines being used against them in the courtroom if the physicians do not follow them exactly (Fuerst, 1997).

There are three main mechanisms for sustaining concussions. Linear acceleration is when a forcible blow to the head causes the head to continue to move in a linear direction. The injury caused by a linear acceleration is usually at the site of impact, and is called a coup injury. This type of injury can cause localized swelling resulting in coordination, balance, and posture problems. The second mechanism for sustaining a concussion is a linear movement of the head contacting an immovable object, such as the ground or the wall. With this mechanism, the injury generally occurs directly opposite from the area of impact as the result of the deceleration impact and is called a countercoup injury. The injury occurs opposite the site of impact because the brain compresses against the skull in the opposite direction of the movement. This causes a thickening of the cerebrospinal fluid in the direction of movement, which helps to cushion the brain and protect the area upon impact, causing the injury to occur directly opposite to the site of impact. Head injuries can also occur with a rotational component. "If the cervical spine is taken beyond its normal range of motion, especially into rotation or side flexion, there may be a twisting of the cerebral hemisphere, brain stem, carotid artery, or carotid sinus that results in injury to these structures or ischemia to the brain" (Magee, 1997, p. 59).

With each mechanism of injury, different levels of concussion injuries can occur. A few commonly used concussion classification systems are found within the literature (Zachazewski et al., 1996). The authors of several guidelines are Torg (Vegson & Torg, 1991); Colorado Medical Society, 1991; and Cantu, 1986. There is much discussion and debate over classification systems, and no single standard has been set for evaluation

(Cantu, 1998a), although the Academy of Pediatrics, the American Academy of Sports Physicians, the National Collegiate Athletic Association (NCAA), and the Olympic committee endorse the Colorado Medical Society (CMS) guidelines.

Torg classified concussions on a six level scale (Vegson & Torg, 1991). In a grade one concussion, the athlete exhibits only momentary confusion, brief disorientation, and some unsteadiness. An athlete experiencing a grade two concussion displays some confusion, posttraumatic amnesia lasting under 30 minutes, slight ringing in the ears, dizziness, a dull headache, some disorientation, and possible postconcussion syndrome where symptoms of a concussion are present longer than the expected duration. A grade three concussion has the preceding symptoms slightly escalated with the addition of retrograde amnesia. Severe concussions are graded at levels four and five. At level four, the patient suffers posttraumatic amnesia for more than 30 minutes, retrograde amnesia, and loss of consciousness for less than 5 minutes. In addition, the patient usually has severe ringing in the ears, dizziness, headache, and disorientation, with possible postconcussion syndrome and personality changes. A grade five concussion has those symptoms with amnesia lasting longer than 24 hours and loss of consciousness over 5 minutes. A grade six concussion is death (Vegson & Torg, 1991).

The CMS (1991) established a useful grading system that can easily be applied, but is not intended to replace clinical evaluation by a physician. The CMS graded concussions into three levels. A grade one concussion is when an athlete sustains brief confusion without amnesia or a loss of consciousness. Many athletes equate a grade one concussion with getting "their bell rung." Although these concussions are considered to be relatively minor, the athlete should be evaluated before returning to play. A grade two concussion is differentiated from a grade one concussion by amnesia accompanying the confusion. If postconcussion symptoms are persistent for more than 1 week, a CT scan

or MRI is recommended. A grade three concussion is characterized by loss of consciousness. Athletes suffering a grade three concussion should be referred to a medical facility as soon as possible for a full evaluation and possibly a CT scan or MRI.

Cantu (1986) limited the concussion grading system to three levels, similar to that of the CMS. Grade one concussions are considered mild and are characterized by no loss of consciousness and posttraumatic amnesia lasting less than 30 minutes. This level of concussion is the most difficult to assess, but is most common. It is estimated that 50% to 90% of all concussions are grade one. Moderate concussions, level two, include loss of consciousness less than 5 minutes and posttraumatic amnesia for more than 30 minutes. Grade three concussions are characterized by loss of consciousness longer than 5 minutes and posttraumatic amnesia lasting over 24 hours.

Cantu (1986) based his grading system on his personal on-the-field experiences evaluating athletes. His scale is intended to be easily applied to real life situations. The CMS (1991) concussion grading scale is similar to Cantu's (1986) guidelines except for a distinction between grades two and three. For the CMS, confusion, no amnesia, and no loss of consciousness distinguish a grade one concussion. Confusion, amnesia, without loss of consciousness characterizes a grade two concussion. For the CMS (1991), the athlete losing consciousness characterizes grade three concussions.

Once a concussion is sustained, the patient could suffer from posttraumatic syndrome. Gronwall and Wrightson (1974) suggested that athletes who have sustained a concussion may experience decreased information processing speed. Research has found that recovery varies between patients. However, when symptoms last longer than the normal expected recovery time, the patient is suffering from posttraumatic syndrome. Postconcussion recovery time may take up to 35 days or more for symptoms to subside (Gronwall & Wrightson, 1974). Symptoms associated with postconcussion syndrome

include continuous headaches, poor concentration, mood changes, and fatigue. Any athlete exhibiting these persistent symptoms should seek medical attention. In addition, a CT scan or MRI may determine the severity of the injury. Athletes suffering from a concussion need to have activity monitored until symptoms are resolved to avoid exacerbating the injury and putting the athlete at risk for sustaining a second concussion (Cantu, 1998a; Zachazewski et al., 1996).

Second Impact Syndrome

One traumatic outcome of a concussion can be second impact syndrome (SIS). After an initial concussion, an athlete generally exhibits postconcussion symptoms such as dizziness, headaches, and mental difficulties. SIS occurs when an athlete returns to play before these symptoms have resolved and sustains a second concussion. Although the second concussion may be minor, the next few seconds separate SIS from a standard concussion. An athlete suffering from SIS after the second concussion has been sustained will appear dazed as if suffering from a grade one concussion. However, within a few seconds to a few minutes, the athlete will collapse to the ground, become "semicomatose with rapidly dilating pupils, loss of eye movement, and evidence of respiratory failure" (Cantu, 1998b, p. 38).

Gronwall and Wrightson (1975) found when an athlete has sustained multiple concussions along with neurological deficits resulting from a concussion, recovery time is increased and information processing speed may be slowed. The cumulative effect of multiple concussions may be due to neurological damage. With each successive concussion, more neurons are destroyed, making the loss of others more evident when assessing the mental functions of the athlete (Gronwall & Wrightson, 1975).

SIS is rare. Only 22 cases of SIS were diagnosed by the National Center for Catastrophic Sports Injury Research (Cantu, 1998b). Although rare, SIS can have

catastrophic outcomes with a 50% mortality rate and almost 100% morbidity rate. Refraining from contact sports until all symptoms have subsided is essential. Many athletes fail to report symptoms from a minor concussion because they fear being withheld from play. They do not realize the gravity of their condition. Educating athletes and parents to recognize of concussions and postconcussion symptoms is extremely important because SIS can be prevented (Cantu, 1998b).

Injuries in Football

Head and neck injuries must be treated with great care because of possible traumatic outcomes after the injury. The catastrophic sports registry cites sports as putting people at the greatest risk of incurring a severe injury per 100,000 participants (Cantu, 1998a). Athletes have significant injury risk in many different sports, including gymnastics, ice hockey, martial arts, wrestling, horse racing, car racing, and rugby. Football, with its high number of participants, ranks the highest among all sports with 250,000 minor head injuries per year (Gerberich et al., 1983).

In football, a variety of severe head and neck injuries can occur during practice and competition. Occasionally players die from these injuries. The most significant risk of catastrophic head and neck injuries for football players occurs during tackling, which includes spearing and head first contact (Cantu, 1998a; Heck, 1996). According to Drake (1996), between 1989 and 1993, an average 2.4 high school football players died annually from football-related injuries, and 7.6 players suffered an injury causing irreversible damage to their spinal cord. There have been no fatalities directly related to football on the semi-professional or professional level since 1972, although an average of every four years, an athlete suffers permanent spinal cord damage (Drake, 1996).

Rule changes have reduced the number of severe head injuries. In 1972, head-first tackling, referred to as spearing, was banned from high school football in hopes of

reducing the number of severe injuries. However, a study by Heck (1996) showed no reduction in spearing as a result of the rule change. Nevertheless, many authors feel the rule change has significantly improved safety for football players (Zachazewski et al., 1996).

Of all head injuries, the most common are concussions. In football, concussions are the fifth most frequently occurring injury (Kelly, 1996; Zemper, 1994). McKeag et al. (1994), in a concussion outcome study, found 63% of all sport-related concussions were related to football. Rugby, basketball, hockey, and soccer followed at 6%, 6%, 5%, and 4%, respectively. Football concussions commonly stem from helmet-to-helmet contact, helmet-to-knee contact, or helmet-to-turf contact. According to Kelly (1996), 20% of high school students and 10% of collegiate players will suffer a concussion each season. On the basis of these statistics, an estimated 250,000 concussions occur each year in scholastic football players.

Football is a contact sport putting athletes at risk for head injuries. Unfortunately, many minor concussions are unreported because they are only thought of by players and coaching staff as a "ding" or "getting your bell rung," and not thought of as a concussion or a significant head injury. Mild concussions account for an estimated 50% to 90% of all concussions (Cantu, 1986, 1998b). Most athletes will recover from a mild concussion without any complications. However, there is a chance for severe complications and lasting neurological deficits (Alves, 1991).

Limited research exists regarding recovery time curves and the long-term effects associated with sustaining multiple concussions. Alves (1991) designed a prospective study to address these issues. Initially, football players at 10 universities were tested preseason with neuropsychological assessment testing and a questionnaire regarding their grade level, sport activity, position, previous history of head injury. During the season,

athletes were retested within a 24 hour period after sustaining a concussion. Team athletic trainers recorded details regarding the location, activity, time, and signs and symptoms of the concussion. The player then participated in 5 and 10 day follow-up testing sessions. Twelve weeks post season, about 50% of the injured and 50% of the uninjured players were retested. A control group of random students and a group of athletes suffering from orthopedic injuries were also tested for comparison.

Alves (1991) found that 55.8% of mild concussions were sustained during game competition. The concussion injury rates during games and in-season practices were not related to fatigue. During preseason training, when most teams have multiple practices per day, 49.2% of concussions sustained were during the final third of practice, which could be associated with fatigue or scrimmaging drills taking place at that time. However, Dickinson and Schramel (1966) found minimal correlation between concussion injuries and fatigue during activity. Alves (1991) found that impact directed at the head accounted for 67.9% of all injuries, with helmet-to-helmet contact being the most common at 22.1%. This finding was also corroborated by the findings of Dickinson and Schramel (1966).

Risks of sustaining a concussion increased depending upon the play the team ran and the position of the athlete on the field. Alves (1991) found 51.6% of concussions occurred during running plays, while only 17.2% and 22.6% occurred in passing and kicking plays, respectively. Concussions also appear to be more frequent (44%) when the athlete is making a tackle or blocking an opponent compared to being tackled or blocked (32%). The remainder of concussions (24%) occurred in practice or special team plays. Special team members, receivers, defensive backs, and linebackers seem to be at increased risk. However, this risk could be associated with the type of offense or defense the team ran and the number of plays each player executed.

Buckley (1988), using the National Athletic Injury/Illness Reporting System (NAIRS) system over an 8 year period, found running plays and blocking plays to be associated with the greatest risk. The highest risk for defensive players, especially defensive linemen, was associated with being blocked. Wide receivers were found to be at high risk while being tackled on passing plays. The lowest risk found with offensive and defensive players was during tackling on passing plays. The quarterback is rarely at high risk of suffering a concussion, but risk increased while being tackled. Gerberich et al. (1983) found making a tackle to be the highest degree of risk at 43%. Only 23% of concussions occurred while being tackled. Blocking and tackling account for 20% and 10%, respectively, of concussions sustained.

A concussion outcome study by McKeag et al. (1994) considered variables related to football concussions including player position, type of play, mechanism of injury, initial symptoms, and return to play. Linemen most frequently experienced concussions (27%), followed by wide receivers (20%), running backs (16%), linebackers (14%), defensive backs (10%), special team players (8%), tight ends (4%), and quarterbacks (2%). Twice as many concussions (64%) occurred during games compared to (33%) practices and scrimmages (2%). The most commonly occurring mechanisms of injury were contact with an opponent (64%) or their own teammate (21%). Only 8% of concussions were sustained with ground contact, 1% occurred from equipment, and 6% from other mechanisms. The initial symptoms were headaches (73%), confusion (62%), disorientation (46%), dizziness (44%), and memory loss (40%). After the concussions were assessed, 67% of the athletes missed no games, and 21%, 7%, 4%, and 1% of players missed one, two, three, or four or more games, respectively. More athletes were withheld from practice with 36%, 18%, 7%, 15%, 6%, and 18% missing zero, one, two, three, four, or five or more practices.

In assessing player performance patterns, Alves (1991) used a neuropsychological protocol that included the Reitan Trailmaking Tests A and B, the Smith Symbol Digit Test, Gronwall's Paced Auditory Serial Addiction Task (PASAT), and Ammon's Quick Test. Alves (1991) found the group of athletes with concussions yielded a significantly different curve than the control group of athletes without injuries and the group of athletes only sustaining orthopedic injuries. The student controls and athletes sustaining orthopedic injuries showed improvements between the 24 hour and 5 day testing segments, but no further improvements with additional testing. The concussion group showed improvements between the 24 hour and 5 day testing periods, and continued to show improvement between the 5 and 10 day testing periods. This timing seemed to coincide with athletes' complaints of symptoms. The 10 day test and 12 week postseason testing results were the same between the three groups, with subjects appearing to show complete recovery after the concussion (Alves, 1991).

An athlete is four to six times more likely to suffer a concussion with a previous history of sustaining concussions. Dickinson & Schramel (1966) found 40% of the football players sustaining a concussion in their study had suffered a previous concussion.

Return to Play

Gerberich et al. (1983) found 20% of high school football players will suffer from a concussion. The question of when an athlete should be allowed to return to play is crucial. There is no universal agreement regarding when an athlete should return to play after suffering from a concussion. The guidelines outlined by the CMS (1991) and Cantu (1986) for grading concussions also include return-to-play recommendations. Nevertheless, Cantu (1998a) stated that final decisions about return to play should be based on physicians' clinical decisions.

The CMS (1991) suggested return-to-play guidelines to complement their current concussion grading system. If athletes suffer a grade one concussion, the CMS believes they need to be removed from competition and observed for a 20 minute period. If, at that time, athletes are asymptomatic during rest and exertion, they can return to competition. Players sustaining a second grade one concussion during the same day should be removed from competition and evaluated. The season should be terminated if or when a player suffers a third grade one concussion. Such a player should be held from contact sports for at least 3 months and can only return to contact play if asymptomatic at that time. With a grade two concussion, the athlete should be removed completely from competition and monitored for 24 hours, noting any increase in symptoms of postconcussion syndrome that might indicate a more serious injury. The athlete should be withheld from competition 1 week after resolution of symptoms at rest and exercise. An athlete who suffered a second grade two concussion should be withheld from play for a month. Serious consideration should be given to ending the athlete's season. With a third grade two concussion, the athlete's season should be terminated. An athlete suffering a grade three concussion should be benched for a 1 month period after resolution of symptoms and allowed to return-to-play only after being asymptomatic for 2 weeks during rest and exertion. A second grade three concussion should end the athlete's season, and serious consideration should be given to avoiding any future contact sports (Colorado Medical Society, 1991).

Cantu (1986) established general guidelines for return to play coinciding with his concussion grading scale. With grade one and grade two concussions, Cantu believes athletes may return to play after they have been asymptomatic for a 1 week period. After suffering from a grade three concussion, an athlete should be benched for 1 month and may return to play if asymptomatic for 1 week following the 1 month period. Cantu's

(1986) return-to-play criteria also include criteria for subsequent concussions. For a second grade one concussion, the athlete may return to play after 2 weeks if no symptoms appear for 1 week. If a second grade two concussion is sustained, the athlete should be benched for 1 month and may return after being asymptomatic for 1 week. Consideration should be given to ending the athlete's season. Upon a second grade three concussion or a third grade one or two concussion, the athlete's season should be terminated with the possibility of returning to play the following season if no symptoms appear.

To apply the preceding return-to-play guidelines, not only does there need to be accurate assessment and recognition of the concussion, but also the evaluator must rely on the athlete to assess symptoms. Litt (1994) reported on a 16 year-old football player who suffered from a subdural hematoma. Initially the athlete suffered a minor concussion. With the presence of postconcussion syndrome, the athlete underwent a CT that resulted in normal findings. Seventeen days after the initial injury, the athlete reported no further postconcussion symptoms. The athlete then performed exertion tests to see if symptoms could be re-created. With the athlete reporting no increase in symptoms, he was cleared to return to play 30 days after the initial injury. The next game the athlete "collided with an opponent, ran to the sidelines, and began to deteriorate on the sidelines after complaining of dizziness" (Litt, 1994, p. 69). He was treated immediately by the emergency medical staff, rushed to the hospital, and underwent a burr hole craniotomy to treat the hematoma. The athlete stabilized and was released from the hospital 10 days after surgery.

During a follow-up visit 4 months after surgery, the athlete admitted no cessation of symptoms after the first concussion. The symptoms suffered by the athlete were consistent with second impact syndrome and included headaches, sleeplessness, and poor concentration. Other patients suffering from similar symptoms have a 74% mortality rate

and an 8% chance for a successful recovery. Symptoms generally suffered after a concussion relate to the area of the brain that has sustained the injury and lesion (Litt, 1994). Other cases have also been cited where athletes feel the pressures to compete again, so they play with cerebral symptoms from concussions, not realizing they could be seriously jeopardizing their health (Cantu, 1998b).

The American Academy of Neurology calls for standardization of concussion assessment and guidelines (Practice parameter, 1997). A study by McCrea, Kelly, Kluge, Ackley, and Randolph (1997) was the first preliminary study to determine feasibility and clinical validity of the use of a standardized sideline technique for the assessment of concussions in football players. The cognitive examination, which took 5 minutes to administer, was based on the return-to-play guidelines established by the American Academy of Neurology, taken from return-to-play criteria established by the CMS (1991). With three high schools participating in the study, athletic trainers administered the sideline examination to 141 healthy football players. The athletic trainers were then instructed to repeat the examination if they suspected an athlete was suffering from a concussion. During the 1995 season, only 6 of the 141 football players suffered from concussions and all were graded one, mild concussions. All athletes suffering from concussions showed significant differences in learning and delayed recall on the more demanding tasks as compared to the control group. The participating athletic trainers found the test easy to administer, lending to the feasibility of using the standardized test on the field.

Although general guidelines have been established for return-to-play criteria, they are based on the honesty of the athlete during assessment. Making sure athletes are fully recovered from an initial mild head injury is essential to preventing injuries that could

lead to devastating circumstances. Litt (1994) recommends neurological testing to aid in qualitatively assessing an athlete's mental status postconcussion.

Injury Prevention

Injury prevention is essential in maintaining safety on the football field. In preventing catastrophic injuries in football, properly fitted equipment is extremely important (Mueller & Blyth, 1995). This is particularly true for the helmet. Concussions are usually the result of the head contacting another helmet, the ground, an opponent's knee, or taking a blow to the jaw (Chapman, 1993; Kelly, 1996). Because of the mechanisms for sustaining concussions, the proper use of helmets and mouthguards is critical in maintaining the health and safety of football players.

The Helmet

Among other things, helmets have been designed to reduce the number and severity of concussions sustained during football (Zemper, 1989). Although the National Football League (NFL) has recently celebrated its 76th anniversary, football helmets have been mandatory equipment for just over 50 years in the NFL and scholastic programs (Gaffney, 1995). Since its creation in early 1896 at Rutgers University, the football helmet has undergone numerous changes and advancements to aid in the protection of participants (McWhorter, 1990).

Initially the football helmet consisted of soft leather with flaps covering the ear, called the "head harness." Although the idea of protecting the athlete's head was important, the helmet was criticized for affecting communication during play. Between 1915 and 1917, the first ancestor to today's modern helmet was created. It was the first helmet to offer some suspension so the leather did not directly lie against the athlete's head. It contained holes in the ear flaps to facilitate hearing. During the 1920's and 30's, the helmet underwent further changes including the addition of padding, the use of stiffer

leathers to improve protection, and altering the shape of the helmet to more accurately fit the shape of the head. In 1939 and 1940, two of the most significant changes occurred in football helmet construction: the introduction of the plastic football helmet in 1939 and the addition of the first face mask created by John T. Riddell (Gaffney, 1995).

The NCAA required football helmets for the first time in 1939. However, the NFL did not require the use of helmets until 1943 (McWhorter, 1990). Since its inception, the plastic helmet has been criticized regarding its ability to protect the athlete. Plastic helmets were banned in 1948 because of poor construction. After construction changes were made in 1949, the plastic helmet was reinstated. Since that time, manufacturers have continued to make improvements including finding new materials, such as polycarbonate plastic and high-tech padding, to increase shock absorption (Gaffney, 1995).

Although there have been numerous changes in the football helmet's construction since its inception, there have been few changes since the 1970's (Gaffney, 1995). Even though there has not been significant change in the helmet to increase safety, manufacturers and researchers note the importance of properly fitting and maintaining the helmet to maximize its head protection capabilities (Cantu, 1998b). In addition, through prolonged use, the suspension webbing can be stretched, reducing the distance between the helmet and the head, and increasing the potential risk for sustaining a concussion. The padding within the helmet can also deteriorate causing a decrease in thickness (Bishop, Norman, & Kozey, 1984). This decrease in distance between the helmet and the head decreases the amount of protection the helmet will provide. (McGuine & Nass, 1996).

To provide standardized maintenance of football helmets, the National Operating Committee on Standards for Athletic Equipment (NOCSAE) was founded in 1969.

Standard criteria for football helmet safety were established in 1973, and the NOCSAE began testing helmets to meet these standards in 1974. By 1978, the NCAA required all helmets to meet the NOCSEA's standards. By 1980, the National Federation of State High School Associations also adopted the NOCSEA standards (Mueller & Blyth, 1995). The development of these standards has led to a decrease in serious head injuries since the NOCSAE established its criteria for certifying protective equipment (Bishop et al., 1984; Zemper, 1994).

In professional and collegiate settings, many teams have equipment managers responsible for maintaining equipment and insuring proper fit. In the high school setting, where equipment managers and athletic trainers are rare, fitting of football helmets is left to the coaching staff and the athletes (McGuine & Nass, 1996). According to McGuine and Nass (1996), 63% of Wisconsin high school football helmets were fitted by coaching staff, 25% were fitted by the athletes, and 12% were fitted by others including athletic trainers or equipment managers. Results of the study showed a significantly greater number of fitting errors when the players or coaches fit helmets compared to other professionals. Many coaches admitted knowing very little about helmet fitting, and McGuine and Nass (1996) suggested that knowledge of fitting helmets for many coaches stemmed from wearing helmets during their own playing careers with no direct training.

There is no standard for fitting football equipment other than the information provided to athletes by the manufacturers. McGuine and Nass (1996) established seven criteria for proper fitting of football helmets. The criteria included:

1. 2.54-cm (1 in.) spacing above eyebrows
2. 5.08-cm (2 in.) minimal clearance from the nose to the face mask
3. chinstrap centered and taut
4. jaw pads snug to the face

5. ear holes aligned with the ears
6. adequate coverage of the posterior cranium
7. minimal shell movement anteriorly or posteriorly

The study showed that in assessing 1671 helmets, 3403 fitting errors were found. The researchers found 62% of the helmets assessed had multiple fitting errors despite available literature on proper fitting of the football helmet. Overall, only 15.4% of the helmets were fitted properly. The percentage of helmets found with one or two errors and helmets found with four or more errors were 47.2% and 15.4%, respectively.

Many of the helmets found with one or two errors could easily be fixed with slight adjustments. Some of these errors could be fixed by tightening the chinstraps, inflating the bladders in the helmets, or placing the appropriate sized jaw pads in the helmet. Some of these corrections made the helmets feel uncomfortable, and athletes were found to release air out of the helmet's bladder or loosen the chinstrap to increase their comfort (McGuine & Nass, 1996). For this reason, McGuine and Nass (1996) suggested that fitting the helmet once at the beginning of the season was not adequate. Monitoring helmet fit throughout the season is necessary to maintain the proper fit. Zachazewski et al. (1996) suggested that air bladders in the helmet need to be monitored on a daily basis to insure proper fit.

Helmet fitting errors were found to be associated with the person responsible for fitting the helmets, and the number of errors was also associated with the athlete's class level within the school. Freshman were found to have the highest number of fitting errors with an average of 2.54 errors per helmet, followed by sophomores, juniors, and seniors with 2.03, 1.81. and 1.80 errors found per helmet, respectively. Some errors could be attributed to freshman having the last choice for equipment (McGuine & Nass, 1996). Although schools would like to have a large selection of equipment, they have limited

budgets. A second reason for the high number of fitting errors was helmets being too large for freshman, even when the smallest helmet was fitted on the smallest player (McGuine & Nass, 1996).

McGuine and Nass (1996) also assessed the number of fitting errors found within the helmet brand the athletes were wearing. The three most commonly used helmets in the Wisconsin high school district were the Air, the Max-Pro, and the Riddell helmets. Of major brand names, the Air helmet was found to have the most errors occurring per helmet at a rate of 2.34. The Max-Pro was second with an average of 2.03 errors per helmet, followed by the Riddell with 1.84 errors per helmet. The highest number of errors, at 2.89 errors per helmet, was found in the five helmets that were not major brands (McGuine & Nass, 1996).

Although poor fit due to human error can lead to injury, some helmets may be predisposed to increasing one's risk of sustaining a concussion. Zemper (1994) found a significant difference in the concussion occurrence rates between different brands and models. Riddell, Bike, and MaxPro manufactured the most common football helmets, with various models of each brand in use. Over a five season period, most helmets performed within a reasonable range of injuries, but there were a couple of models performed better than expected. The Bike Air Power and Bike Pro Air models both presented concussion injury rates exceeding expected rates. The Riddell M155 and MaxPro Super Pro had fewer injuries than would have been expected during the five seasons. Although Zemper (1994) suggested that more on-field investigation must be conducted, the quality and effectiveness of equipment used is extremely important.

Athletic equipment is made to protect athletes from possible injury during play. Although protective equipment cannot eliminate injury, it helps distribute forces to avoid serious injury. Although some protective equipment may be superior to others, the

equipment should be used to its full potential. The purpose and role of the equipment must be clearly explained to the user. The equipment must be fitted properly and adequately maintained (Cantu, 1998b; Zachazewski et al., 1996; Zemper, 1994).

The Mouthguard

Mouthguards are now the most commonly used piece of protective equipment in contact sports (Jennings, 1990). These sports include ice and field hockey, lacrosse, rugby, football, boxing, soccer, basketball, and wrestling (Kerr, 1986). Mouthguards provide wearers with protection not only against injuries to teeth, gums, and jaws, but help protect athletes against facial lacerations and head injuries, including concussions and dislocations, and neck injuries through shock absorption (Jennings, 1990; Kerr, 1986). The protection can be attributed to the mouthguard increasing the distance between the mandibular condyles and the skull. This helps decrease the force distribution after impact (Jennings, 1990). By absorbing shock sustained by the jaw during impact, the number of concussions can be reduced. This is extremely important because the most common cause of concussions in sports is a blow to the jaw (Chapman, 1993).

In boxing, face and head injuries are quite common. In 1913, a boxer was the first to use a mouthguard to help provide some added protection during competition. Research into the benefits of mouthguards came to the forefront in 1962 when 25% to 30% of injuries in football were associated with dental injuries. Researchers have found a 90% to 100% reduction in dental injuries when athletes wear mouthguards during contact play (Jennings, 1990). In 1962, mouthguards became required protective equipment in high school football. By 1974, the NCAA required the use of mouthguards in collegiate football (Kerr, 1986). Heintz (as cited in Kerr 1986) stated before the requirement of mouthguards in football, 50% of injuries were related to the mouth and

face. After the initiation of the new rule, the rate for facial injuries dropped to less than 1% of injuries in high school and collegiate football.

Because of their ability to absorb shock, mouthguards provide protection from fractures, dislocations, and concussions . To be able to provide this type of protection, the mouthguard must fit properly and cover the surface area of all the teeth. Mouthguards should be made of durable, light material that is easy to maintain. It is extremely important that mouthguards are comfortable to wear and not interfere with breathing or communication during play. In addition, mouthguards must be made affordable so they are easily accessible to all participants (Jennings, 1990; Kerr, 1986).

Currently, there are no standards for the construction of mouthguards, but Scott et al. (as cited in Greasley & Karet, 1997), has established current practices and described the following suggested characteristics. The mouthguard should:

1) enclose the maxillary teeth to the distal surface of the second molars.
2) be 3 mm thick on the labial aspects, 2 mm on the occlusal aspect, and 1 mm on the palatal aspect.
3) have the labial flange extend within 2 mm of the vestibular reflection.
4) have the palatal flange extend about 10 mm above the gingival margin.
5) be round the edge of the labial flange in cross section, and the palatal edge should be tapered.

There are several different types of mouthguards available. Athletes can choose from custom made, factory-molded, and self-molded (boil and bite) mouthguards. Most mouthguards cover the maxillary teeth, but double mouthguards protecting both upper and lower jaws are also available. As the literature shows, mouthguards are essential in injury prevention, and some mouthguards are more effective than others in overall performance during competition (Greasley & Karet, 1997; Jennings,1990; Kerr, 1986).

Custom-made mouthguards have been shown to be the most effective in injury prevention (Jennings, 1990; Kerr, 1986). Custom mouthguards meet all player concerns and the criteria of acceptable standards according to Scott et al. (as cited in Kerr, 1986). Although custom mouthguards are more expensive than over-the-counter products, "the cost-benefit ratio clearly shows they are a worthwhile investment. Numerous studies have shown that they reduce the incidence, severity, and extent of orodental injuries" (Chapman, 1993, p. 197).

Self-molded mouthguards are the most commonly used mouthguards in contact sports. The popularity of the self-molded mouthguards is likely due to the affordable price and accessibility of the mouthguards to the general public (Jennings, 1990). Self-molded mouthguards can be purchased in sporting good stores and easily fitted. The player, coach, or athletic trainer molds them by dipping the mouthguard into hot water to soften the plastic and then fitting it onto the maxillary teeth of the athlete. Although self-molded mouthguards aid in injury prevention, Greasley, Imlach, and Karet (1998) found all custom made mouthguards perform better than the self-molded mouthguards. Concerns have been cited regarding the thinning of the self-molded mouthguards during the fitting. The molding process might thin the mouthguard below acceptable standards and may reduce the protection afforded (Greasley & Karet, 1997).

Self-molded mouthguards may be a valuable option for young children who are still growing. With growth, mouthguards will need to be replaced every year or two to maintain proper fit. Wearing over-the-counter, self-molded mouthguards is reasonable because injury risk increases with age. At young ages, the chance for sustaining an injury is relatively low, so the self-molded mouthguard would be suitable and is much safer than wearing no mouthguard at all (Chapman, 1993). "It is far more likely that a player will continue to wear a gum shield if he starts early in life" (Jennings, 1990, p. 164).

Generally, factory-molded and bimaxillary mouthguards are not considered to be an ideal choice in protection. Factory-molded mouthguards often fit poorly and are usually held in place by clenching the teeth. This can cause difficulties with breathing and communication, and probably discourage an athlete from wearing the mouthguard regularly (Chapman, 1993; Greasley & Karet, 1997; Jennings, 1990). Factory-molded mouthguards have also been found to dislodge during contact and possibly cause airway obstruction leading to respiratory distress. They should never be recommended for use (Chapman, 1993; Jennings, 1990). Although bimaxillary mouthguards are available, they are limited. These mouthguards provide necessary protection, but significantly limit breathing and communication when in place. Therefore, these mouthguards have been deemed unacceptable for use during competition (Greasley & Karet, 1997).

One important way to increase mouthguard use during practice and competition is to educate athletes, coaches, athletic directors, parents, and physical education teachers on the role mouthguards play in injury prevention. Jennings (1990) found in a study of rugby players that only 79% to 88.4% of the athletes believed that mouthguards provided protection against injury. Very few of them realized the role mouthguards play in the reduction of sustained head injury. "Parents have the biggest influence on instigating the use of gum shields at an early age. Therefore, it is important for the parents to be well informed" on the role mouthguards play in injury prevention (Jennings, 1990, p. 165).

Parent Education

High risk contact sports put participants at a greater risk for injury. At the high school level, athletes, physicians, athletic trainers, coaches, athletic directors, administrators, and parents are responsible for making educated decisions regarding an athlete's ability to safely participate in the sport. Numerous authors, including, Goldhaber (1993), Glassman (1996), and Mueller (1991) cite the importance of injury

prevention in reducing concussions and catastrophic outcomes. Although prevention is essential, The National Youth Sports Safety Foundation (NYSSF), a nonprofit educational research organization, noted various barriers in implementing injury prevention in youth football. Barriers include misinformation; attitudes of athletes, coaches, administrators, and parents; poor dissemination of information; lack of education; and inadequate injury surveillance. The NYSSF believes many injuries can be prevented through education (Glassman, 1996).

In the high school setting, parents play a critical role in decision making regarding their child's health. Yet, Goldhaber (1993) found parents have little knowledge concerning head injuries associated with football, the helmet's role in the protection of head injuries, or the overall risks associated with playing contact football. In a sample survey of parents with children currently or recently involved in high school football, "546 (54%) of parents mentioned knee injuries and 406 (40%) mentioned broken bones as injuries sustained in football. Hardly any parents (less than 1%) mentioned severe brain damage as being associated with playing high school football" (Goldhaber, 1993, p. 307). Even when parents were prompted on the possibility of severe brain injury, only 25% considered it to be an injury associated with football. Along with the assumption that severe brain injuries were not associated with football, 80% of parents believed helmets almost completely negated the possibility of severe brain injury, 69% believed helmets completely eliminated the possibility of concussions, and 29% believed helmets prevented the possibility of sustaining a broken neck. These findings on parents' beliefs vary greatly with the findings of Gerberich et al. (1983) that one in five high school players will suffer from a concussion.

Goldhaber (1993) also found parents received little information on the risks associated with football. Eleven percent of parents had received written information,

which was generally either from permission slips or waivers from the high school, from newspapers, or from television segments. Helmets are labeled with a warning that states, "do not strike an opponent with any part of this helmet or face mask. This is a violation of football rules and may cause you to suffer severe brain or neck injury, including paralysis or death....No helmet can prevent all such injuries" (Goldhaber, 1993, p. 309). Goldhaber (1993) found 0.5% of parents had received information regarding possible brain injury from the football helmet's warning labels. Also, 27.6% of parents though football helmets could provide complete protection against the risk of severe brain injury and only 36.9% of parents were aware of the presence of warning labels on the helmets. Of the parents who were aware of the warning label on the football helmets, 81.8% of the parents did not know what the label said, and only 2.2% knew that it mentioned the risk of severe brain injury.

Goldhaber (1993) cited literature suggesting that the more familiar athletes or parents are with a piece of equipment, the less likely they are to associate dangers with using the product. This practice is even more common with teenage males because they are more willing to partake in risky activities and disregard safety warnings. Most educational information regarding football safety is directed towards coaches and players, yet parents are responsible for making educated decisions regarding their children's safety. There is no evidence that players who are educated about possible risks associated with football share that information with their parents. The results of this survey showed few parents received information regarding risks associated with football from their children.

With access to current research and NOCSAE testing and information regarding risks associated with football, helmet manufacturers should take an active role in educating parents. Through written materials, including brochures, video tapes, and

educational seminars, manufacturers can play an active role in educating participants. Coaches, school administrators, and athletic trainers need to play an active role in disseminating the information to parties involved (Goldhaber, 1993).

Reducing Liability

Catastrophic head and neck injuries in football rarely occur. When they do, there is likely to be a lawsuit holding the high school administrators, medical staff, coaches, and parents responsible (Heck et al., 1994). Athletes and parents often will not admit an accident is the result of bad luck or judgment. They feel someone else is responsible for the outcome and should take financial responsibility (Granger, 1996). Athletic departments need to take the necessary steps to reduce lawsuits by establishing risk management programs. Most settlements top 1 million dollars (Granger, 1996; Heck et al., 1994).

Heck et al. (1994) addressed concerns including legal considerations, liability insurance, general lawsuits against athletic staffs, and defenses used in lawsuits. An important part of protecting against potential liability is understanding who can be held accountable for what and the legal terms associated with lawsuits. A tort is "a civil wrong, other than breach of contract, of which the court will provide a remedy in the form of an action for damages" (Heck et al., 1994, p. 128). Someone is negligent when the standard of care or conduct is below limits set by established law, which is usually guided by how a prudent person in a similar situation would act. Gross negligence is being negligent and showing no concern for the situation. Willful, wanton, or reckless negligence is intentionally acting in complete disregard for safety. Only six states recognize contributory negligence. However, in these states, contributory negligence is a strong defense because if plaintiffs are responsible for any of their own injuries due to their particular actions, they will not receive any damages in a settlement.

The states not recognizing contributory negligence have replaced it with comparative negligence. Comparative negligence is assessing damages in a case relative to the amount of fault associated with each person. Plaintiffs release rights to collecting damages if they have willingly exposed themselves to a known risk associated with an activity. The player or guardian assumes the risk. Some states do not recognize assumption of risk, or associate it with comparative negligence.

Informed consent is when, prior to any treatment or involvement in a procedure, the person knowingly and intelligently has given consent to participate in an activity. Finally, joint and several liability is when "the defendants are responsible together and individually for damages" (Heck et al., 1994, p. 129). This means that the full settlement can be collected from defendants regardless of their percentage of fault in the accident.

Lawyers tend to target lawsuits against coaches, schools, and athletic associations (Tally, 1985). Five of the most common areas focused on for litigation include failing to give adequate instruction, failing to provide appropriate equipment, scheduling inappropriate opponents in competition, poorly supervising, and providing improper emergency protocols (Heck et al., 1994). In Wissel v Ohio High School Athletic Association, a quadriplegic high school football player sued his coaching staff citing they did not inform him of proper tackling techniques, the use of proper protective equipment, and understanding the warning labels on football helmets. In Gerrity v Beatty, the school district was brought to court charging that it had not provided the athlete with a properly fitting football helmet. In Low v Texas Tech University, the coaching, management, and medical staffs were charged with failing to provide proper protective equipment. In Vendrell v School District, the coaching staff was alleged negligent in not safely assessing the experience of a freshman football player on the varsity team and his ability to compete safely during varsity competition. In Jarreau v Orleans Parish School Board,

the coaching staff and school board were cited for allegedly not taking proper injury procedures and delaying medical care and diagnosis for an injured athlete (Heck et al., 1994). In Baker v Briarcliff School District, the coach was cited for failing to protect his athlete from increased risk of injury and for failing to monitor her wearing a protective mouthguard during practice (Field hockey, 1995).

Administrators, coaches, and medical staff use different defenses in suits brought against them. "Several states, by statute, confer total or limited immunity to schools or teachers while acting in the normal scope of their duties" (Heck et al., 1994, p. 132). Another common defense is the assumption of risk by the athlete and the athlete's family as an inherent part of the sport. So, it is extremely important that athletes and parents of minors are well informed of risks associated with their sport, especially football, by using videotapes, seminars, and assumption-of-risk forms. These steps will help protect schools and clubs during litigation. Also, using a documented source, such as a video tape that can be reviewed by a jury to show that athletes and parents were informed of risks, is strong evidence in a legal defense. To protect themselves in court, administrators have also used waivers releasing parties from liability. Providing educational safety seminars for parents of high school players to inform them of risks associated with playing football and other contact sports and documenting all information distributed is essential in establishing a good risk management program (Granger, 1996; Heck et al., 1994).

Summary

Roughly 1,500,000 junior high and high school players participate in football (Lucenko, 1996). Some 250,000 minor head injuries occur annually, ranking football the highest of all sports in the number of concussions sustained (Cantu, 1998a). Many of these concussions, minor head injuries, and traumatic outcomes can be prevented (Cantu,

1998b; Glassman, 1996; Goldhaber, 1993; Jennings, 1990; Kerr, 1986; Mueller & Blyth, 1995).

Mild concussions are the most commonly occurring type of concussion (Cantu, 1986, 1998b). Proper diagnosis and monitoring can prevent traumatic outcomes such as SIS from happening and patients sustaining permanent neurological damage (Cantu, 1998b; Gronwall & Wrightson, 1975). Understanding concussion grading guidelines and return-to-play criteria along with a physician's clinical evaluation is extremely important for preventing further injury.

The helmet also plays a significant role in reducing the number and severity of concussions during football (Zemper, 1989). A helmet must be fitted properly to ensure an athlete's safety. Unfortunately, at the high school level, McGuine and Nass (1996) found numerous fitting errors in high school football helmet fitting. Also, people did most of the fitting with little education on how to properly fit a football helmet.

Mouthguards are extremely important in preventing fractures, dislocations, and concussions because of their ability to absorb shock from a blow to the head or jaw. With the use of mouthguards, dental injuries were reduced 90% to 100% in contact sports (Jennings, 1990). Mouthguards are required in high school and collegiate football, but there are no stipulations on the type of mouthguard required (Kerr, 1986). Custom mouthguards have been found to provide the best protection from incidence and severity of injuries during contact (Chapman, 1993; Jennings, 1990; Kerr, 1986).

In high school, parents are responsible for the health of their minor children. However, Goldhaber (1993) found parents to have little knowledge regarding head injuries in football and risk of concussions. They were also unaware of warning labels on football helmets informing users of the potential risk of severe brain damage. Parent education is extremely important to reduce the overall risks associated with football.

Parent education can help ensure helmets and mouthguards are fitted properly and that injured athletes follow reasonable guidelines for return to play along with a physician's diagnosis. By understanding issues associated with head injuries in football, educated decisions can be made regarding an athlete's health which could, in-turn, reduce the number and severity of injuries sustained.

Chapter Three

Methodology

With over 1,500,000 adolescents participating in junior high and high school football (Lucenko, 1996), an estimated 250,000 concussions occur annually in football (Cantu, 1998b). Among all sports, football ranks the highest with the number of severe injuries during fall sports (Lucenko, 1996). The purpose of this project is to educate parents through a booklet and presentation on the occurrence of concussions, general guidelines for return-to-play criteria, and the role of helmets and mouthguards in concussion prevention.

This chapter will contain the methodology for the completion of the project. Initially, the creation of the reference booklet and manual will be discussed. The second section will discuss the subjects who will attend the presentation, review the booklet, and evaluate the overall project. The chapter will be concluded with the evaluation process for the project, which will have two different components.

Reference Materials

A reference booklet for parents was created covering an overview of concussions and return-to-play criteria. It includes conservative guidelines for properly fitting a helmet and safety information regarding the use of helmets. The use of mouthguards is also addressed. Information on the different types of mouthguards available and their effectiveness is also be discussed. The material concludes with a reference sheet on signs and symptoms to be aware of after someone sustains a concussion.

The reference booklet is 10 pages long. The length is 8 1/2 inches (21.59 cm) by a width of 5 1/2 inches (13.97 cm). The layout for the booklet is designed with Presswriter, a Macintosh-compatible desktop publishing program. The outside of the book is done in color on stiff cover sheet. The cover has an eye-pleasing design with a

clip art football player. The text on the inside will be done in black and white print in a 10 point font. The booklet initially begins with a table of contents followed by the text. Concussion grading guidelines and return-to-play guidelines are presented in a graph form for reference. Throughout the text, key points are highlighted in boxes and topics are clearly titled. The text concludes with a reference list for further reading in areas of interest. On the back cover, there are signs and symptoms of concussions for easy reference. Throughout the booklet, clip art is used to catch the reader's eye. Two staples bind the booklet.

To aid in the presentation of the parents' reference booklet, a manual was designed for administrators to use in presenting the information to parents. The manual is about 80 pages long with plastic binding. The manual contains all the information in the parents' reference, but is more in depth in hopes of answering any question parents might have during the presentation. The manual's text is in black and white print. The material is presented in the order it appears in the parents' booklet. The manual includes an extensive list for resources in areas of interest segmented by subject. The information included in the manual is complimented by a 45 minute Power Point presentation on disk for the school to use. The Power Point presentation aids in the presentation of a professional seminar and helps capture and maintain the attention of the audience. The presentation has been done for Macintosh and PC compatible computers. For schools without access to computer projection panels for a Power Point presentation, presentation masters will be included for easy reproduction onto transparencies.

Presentation

At the beginning of the Fall 1999 football season, the presentation was given to the Redwood High School Pigskin Club, a parent support group for the Redwood High School football team. Initially, parents completed a pretest questionnaire to assess prior

knowledge of concussion risks associated with football, return-to-play criteria, and the role of the helmet and mouthguard in concussion prevention. Each parent was then given the reference booklet and a 45 minute presentation. After the presentation, parents completed the posttest questionnaire. There was an additional 15 minute period for questions and answers.

Evaluation Procedure

The reference booklet and presentation manual were evaluated two different ways. Professionals in related fields will evaluate the quality and content of both. The educational value of the presentation manual and booklet will also be assessed by parents via pretests taken prior to the presentation and posttests taken at the conclusion of the presentation.

Professional Evaluation

The reference booklet and presentation manual were distributed to professionals in the field for assessment of quality and content (see Appendix E). The materials were distributed to three athletic trainers, two physicians, and two high school administrators. The athletic trainers were selected from local high schools. The physicians were team doctors from Palo Alto Medical Clinic who have extensive experience in concussion assessment in athletes. The physicians from Palo Alto Medical Clinic and high school athletic trainers were referrals from colleagues. The high school administrators were from the Tamalpais Union High School District. The administrators have had experience in overseeing high school athletic programs. They were referred via the vice-principal at Redwood High School. Each professional was given a survey evaluating the content, professionalism, and quality of the materials and overall project.

Evaluation of the Reference Booklet

The reference booklet was evaluated for its educational value by parents from Redwood High School who could not attend the presentation. Parents unable to attend the presentation, but interested in the material, were given the booklet along with the pretest and posttest. The parents were asked to complete the pretest prior to reviewing the booklet (see Appendix B) to assess their current knowledge of concussion issues associated with football. They were then given as much time as needed to review the booklet. After they had reviewed the material, they were asked to complete the posttest, which will have identical questions in a different order (see Appendix C). A dependent t-test was used to determine if there was a significant difference between the pretest and posttest scores.

Evaluation of the Presentation

Prior to the presentation, the parents were administered a pretest on their current knowledge of concussion issues associated with football (see Appendix B). Initially, no feedback was provided regarding the subjects' responses. The parents were then given the booklets and presented the information. The posttests, with the same questions in a different order, were given to the parents after the presentation to evaluate their knowledge after being exposed to the materials (see Appendix C). The tests consisted of 15 true and false questions. A dependent t-test was conducted to determine if there was a significant difference between pretests and posttests. The statistical findings determined from the questionnaires the overall educational value of the presentation.

Chapter Four

Results

The purpose of this project was to create a booklet and presentation manual to increase parents' knowledge of concussion issues related to high school football. This chapter will discuss the results of the evaluation process. The educational value of the booklet and presentation was assessed via pretests and posttests completed by parents. The educational value of the booklet alone was assessed through pretest and posttest evaluations. Lastly, professionals evaluated the quality and content of the presentation manual and booklet.

Educational Evaluation

To assess the educational value of the presentation and reference booklet, the material was presented to the Redwood High School Pigskin Club parents. Due to low parents attendance for the spring 1999 football season presentation, the presentation was repeated at the beginning of the fall 1999 season. At one of the first league games in fall 1999, the reference booklet was distributed to parents who were unable to attend either of the presentations.

Presentations

The presentations were given to members of the Pigskin Club, a parent support group for Redwood High School's football program. Prior to the presentation all parents were notified about the presentation via a newsletter informing them of the topic, date, time, and location of the presentation. The presentation was given in a classroom using Power Point software on a multimedia projection station. Both presentations lasted about 60 minutes including time for questions and answers throughout the presentation and at the conclusion. Parents were given a packet including the informed consent form, pretest, and posttest. Prior to the presentation, the parents were asked to review the informed consent form. Once they agreed to participate in this thesis project, they were asked to complete the

pretest. Upon completion of the pretest, the parents were given the presentation and reference booklet. After their questions were answered, the parents were asked to complete the posttest. Upon completion of the posttest, they were given an answer key for the test and allowed to keep the reference booklet.

The results from the pretests and posttests were analyzed. Table 1 includes the descriptive data for first and second presentations. A total of 26 subjects attended the presentations and completed the pretest and posttest. Eleven and fifteen parents attended the first and second presentations, respectively. The range between the minimum and maximum number of questions missed was greatest for the second presentation with a range of 8 on the pretest and a range of 5 on the posttest. The second presentation also had the smallest difference between the means of the pretest and posttest with a 1.533 question improvement, while the first presentation resulted in a 3.727 question improvement. The first presentation had an increase in standard deviation of .094 between the pretest and posttest, while the second presentation resulted in a .652 decrease. Table 2 reflects the individual improvements of the subjects on their pretest and posttest after the presentation.

After descriptive data were calculated, the data were analyzed to assess significant differences between the pretests and posttests. A two-tailed dependent t-test was conducted using a p-value $< .05$. The t-test for the first presentation resulted in a t-value of -9.168 and a p- value of $< .0001$. The t-test for the second presentation resulted in a t-value of -2.875 and a p-value of .0122. The p-values from the first and second presentations reflect a significant difference between pretests and posttests on both presentations. Thus, it can be concluded that the presentation and booklet were of educational value to parents of high school football players.

Booklet

The educational value of the booklet was assessed without the presentation. Parents unable to attend the presentation were asked to complete the pretest prior to reading the

reference booklet and then complete the posttest. Thirty-five packets that included the reference booklet; pretest; posttest; informed consent form; and self-addressed, stamped envelopes were handed out; 20 completed packets were returned.

Data were analyzed and are presented in Table 1. The subjects showed an average improvement of 3.05 questions between the pretests and posttests and a decrease in the standard deviation of 0.213. Table 2 reflects the individual results of parents taking the pretest and posttest after reading the booklet. A two-tail dependent t-test was also conducted using a p value < .05 for significance. The t-test resulted in a t-value of -5.362 and a p-value of < .0001. These results reflect a significant difference between the pretests and posttests. These results reflect the educational value of the booklet alone for parents of high school football players

Table 1

Descriptive data for all pretests and posttests

	1st Presentation		2nd Presentation		Booklet	
	Pretest	**Posttest**	**Pretest**	**Posttest**	**Pretest**	**Posttest**
Total Subjects	11	11	15	15	20	20
Minimum	9	11	7	10	6	9
Maximum	12	15	15	15	12	14
Range (min to max)	3	4	8	5	6	5
Mean	9.818	13.545	11.267	12.800	9.200	12.250
Standard deviation	.296	.390	2.549	1.897	1.765	1.552

Table 2

Difference between subjects pretest and posttest results

Subject #	1st Presentation	2nd Presentation	Booklet
1	3	-1	2
2	3	-1	-1
3	4	1	3
4	2	5	3
5	6	-1	0
6	6	3	2
7	3	1	5
8	3	0	0
9	4	3	5
10	2	1	3
11	4	1	5
12		4	0
13		4	8
14		3	5
15		2	6
16			0
17			1
18			5
19			3
20			4

Question Analysis

In addition to determining statistical significance between the pretests and posttests, a statistical comparison was made between each question. Pretests and posttests each consisted of 15 true and false questions. The questions were identical on both tests, but presented in a different order. The statistical comparison used all pretests and posttests completed by parents attending the presentations and assessing the booklet alone, totaling 46 subjects. Table 3 reflects results of the analysis.

The subjects showed improvement on all the questions as a result of either attending the presentation or reading the reference booklet. The question that showed the most improvement regarded mouthguards and whether they should cover both the upper and lower teeth. Most parents did not realize bimaxillary mouthguards were not the ideal mouthguard for football. The least improved question regarded the signs and symptoms of concussion because initially 100% of parents answered the question correctly on the pretest. Most parents were also aware that a concussion could be sustained without an individual losing consciousness.

Table 3

Percentage of questions answered correctly on pretest and posttest

Questions	Answer	% Correct		% Δ
		Pretest	Posttest	
An ideal mouthguard should cover both upper and lower teeth.	F	8.7%	58.7%	50.0%
Every year, one in twenty high school football players suffers a concussion annually.	F	21.7%	56.5%	34.8%
The primary reason for wearing a mouthguard is to protect one's teeth.	F	50.0%	67.4%	17.4%
The majority of all sport-related concussions are associated with football.	T	56.5%	82.6%	26.1%
After a grade three concussion, an athlete may return to competition as soon as all symptoms have resolved.	F	56.5%	84.8%	28.3%
Football helmets come with warning labels on them.	T	56.5%	84.8%	28.3%
Post-concussion syndrome is when signs and symptoms of a concussion last longer than expected.	T	65.2%	89.1%	23.9%
There is one standard guideline for concussion management.	F	67.3%	84.8%	17.5%
Once an athlete has sustained a concussion, the chance of having a second concussion is four times greater.	T	76.1%	89.1%	13.0%
Second impact syndrome (SIS) is a common result of sustaining a second concussion and cannot be prevented.	F	76.1%	89.1%	13.0%
There is no need to refit football helmets during the season, if the football helmet is fitted properly at the beginning of the season.	F	76.1%	93.5%	17.4%
In football, quarterbacks are at the highest risk for sustaining a concussion.	F	76.1%	97.8%	21.7%
An athlete can return to play immediately following a concussion as long as there are no signs and symptoms of a concussion present.	F	80.4%	84.8%	4.8%
An athlete could suffer a concussion without losing consciousness.	T	97.8%	100%	2.2%
Signs and symptoms of a concussion include dizziness, dilating pupils, and ringing in the ears.	T	100%	100%	0%

Professional Evaluation

Two team physicians, two high school administrators, and three high school athletic trainers assessed the quality and content of the presentation manual and reference book. Each professional was given a copy of the presentation manual and the booklet. Each was asked to complete a quality and content questionnaire (see Appendix E). They were asked to rate each question with responses including "strongly agree, "agree", "neutral", "disagree", and "strongly disagree".

All the professionals either strongly agreed or agreed with all the statements on the quality and content evaluation form. The results of the quality and content evaluation forms are presented in Table 4. All the professionals felt the material in the presentation was of professional quality. Most of the professionals felt the presentation manual and booklet covered the material they anticipated and that it was visually pleasing. Most professionals agreed the booklet covered a wide range of topics with only one strongly agreeing. Although most professionals strongly agreed the presentation manual covered the necessary information to make the presentation, they only agreed that the manual covered the necessary background information. Most importantly, 86% of the professionals felt the booklet and presentation manual covered the material that was expected, was visually pleasing, and would be educational for parents of high school football players.

Table 4

Quality and content questionnaire results

Quality and content	Trainer			M.D.		Admin.		% Δ	
	#1	#2	#3	#1	#2	#1	#2	SA	A
The booklet covered the material I expected.	SA	SA	SA	SA	SA	SA	A	86%	14%
The information in the booklet was clear and easy to follow.	A	SA	SA	A	SA	SA	SA	71%	29%
The material in the booklet was presented in a professional manner.	A	SA	A	SA	SA	SA	SA	71%	29%
The booklet covered a wide range of related topics.	SA	SA	A	A	A	A	A	29%	71%
The booklet would be educational for parents of high school or youth football players.	A	SA	SA	A	SA	SA	SA	71%	29%
The booklet is visually pleasing.	SA	SA	SA	SA	SA	SA	A	86%	14%
The presentation manual covered the material needed to make the presentation.	SA	A	SA	SA	SA	SA	A	71%	29%
The presentation material was clear and easy to follow.	SA	SA	SA	A	A	SA	SA	71%	29%
The material in the presentation manual was of professional quality.	SA	SA	SA	SA	SA	SA	SA	100%	0%
The presentation manual provided reasonable background information.	SA	SA	SA	A	A	A	A	43%	57%
The presentation would be educational for parents of high school and youth football players.	SA	SA	SA	A	SA	SA	SA	86%	14%
The presentation manual was visually pleasing.	SA	A	A	SA	SA	SA	A	57%	43%

Discussion

Throughout the process of completing this project, many people have shown interest

in the topic of concussions in football. They have expressed belief in the need for increasing the body of knowledge and educating the public about recognition, care, and prevention of concussions, especially within youth sports.

Both presentations were well received by attending parents. Throughout the presentations, parents were inquisitive and interested in the material presented. Parents did not hesitate to ask questions when they wanted more information about a topic. The parents were interested in arranging a presentation to Redwood High School football players to educate them regarding care, recognition, and prevention of concussions. Parents felt their players would take the information more seriously coming from a professional rather than from the parent.

Interestingly, due to schedule conflicts, the head football coach did not attend the presentation even though he had participated in setting the date and time. When the Pigskin Club approached him about scheduling a presentation for the players, he said he did not have time currently in his schedule and that he wanted to see the presentation before he would allow it to be given to his team. The National Youth Sports Safety Foundation (NYSSF) cited numerous barriers regarding implementing injury prevention and education in youth football. The NYSSF cited attitudes of coaches as being one of the barriers (Glassman, 1996). The head coach's actions at Redwood High School appeared to reflect the findings of the NYSSF.

The statistical findings showed a significant difference between pretest and posttest scores inferring educational value of parents attending the presentation or reading the reference booklet. To support the statistical findings, early in the 1999 football season, several parents expressed appreciation for the information and education regarding concussion prevention and care. Three parents had sons who suffered concussions and had used the information and reference booklet for guidance regarding what actions to take.

The presentation was given twice to two different groups of Pigskin Club parents.

The few parents attending both sessions were not included as subjects in the data for the second presentation. Although demographic data were not collected on the subjects, anecdotally, according to Redwood High School's vice-principal, the subjects attending the first presentation had older sons, and the parents had been involved in high school football for a longer period of time. Those attending the second presentation were primarily parents of freshman players. This may account for the parents at the first presentation, as a whole, performing better on the pretests and posttests. The data from the first and second presentations were analyzed separately because parents raised different questions during the presentation that may have clarified different topics and influenced the knowledge the parents received during the presentations.

The parents from the first presentation had similar amounts of knowledge prior to the presentation as reflect by a having the smallest standard deviation of .296. After the first presentation, the parents' range of questions missed actually increase by 1 and the standard deviation increase by .094. There were also four incidences of subjects performing better on the pretest than on the posttest after the first presentation. Each of these subjects only missed one additional question on the posttest. This difference may be reflected by the subjects being more mentally tired at the end of the evening or not clearly understanding or reading the question.

Parents reading the booklet improved on the pretest and posttest when reading the booklet. They improved an average of 3.05 questions between the pretest and posttest. This increase was greater than the increase after the second presentation. Parents being able to refer to the booklet while taking the posttest may account for the improvement between the pretests and posttest taken by parents who read the booklet.

Some of the questions were missed more frequently than others. Questions about mouthguards were more commonly missed than questions regarding concussions. The most frequently missed question was whether a mouthguard should cover both upper and

lower teeth. Over 90% of parents answered this question incorrectly at first, believing that an ideal mouthguard should cover both upper and lower teeth. After the presentations, only 15% of the parents still answered the question incorrectly; 75% of the parents still answered the question incorrectly after only reading the booklet. This may reflect the presentation more clearly describing characteristics of good mouthguards versus the information found in the booklet.

The second most frequently missed question was regarding frequency of concussions within high school football. Seventy-six percent of parents thought the rate was considerably lower, 1 in 20, than the actual statistic of one in five high school football players sustaining a concussion. After the presentation, 43% of parents still answered the question incorrectly. The lack of improvement on this question may be due to, parents absorbing too much new information, the question being too specific, or the information not being presented clearly in the presentation or booklet.

Information that might be the most educational and beneficial to parents could be derived from the questions that were missed on the pretest and posttest. Parents were very aware of the signs and symptoms associated with sustaining a concussion and that a concussion could be suffered without losing consciousness. On the other hand, parents more consistently missed questions regarding syndromes associated with concussions, mouthguards, and return-to-play guidelines. Future presentations and educational materials may be able to focus less on concussion recognition and more on equipment and post-concussion care.

Several comments were made regarding the booklet and presentation manual when reviewed by the professionals. One high school athletic administrator noted that the materials were "excellent overall; both the idea and the concept." The high school administrators also said the project is something "very needed" and that concussion issues are "becoming more of a hazard to players each year and knowledgeable people need to

guide our youth in the safe direction, so as to minimize and prevent injuries." The studies were cited as being especially effective in getting the main points across. One suggestion for improvement was to streamline the presentation, leaving more detail to the booklet.

The three high school athletic trainers that reviewed the booklet also indicated that the material would be extremely beneficial in the high school setting. The graphics in the booklet were noted as "adding humor" to the material. They mentioned the informal presentation manner being more appealing. Overall they felt the statistics and information were good for all individuals involved with high school football and head injuries.

The two physicians evaluating the presentation felt the material was "good overall." One physician felt the manual would help in his presentations to student athletic trainers. It was mentioned that the terminology should be even more simplified "on the slides and booklet based on the educational level of the target audience." One physician found the presentation "insightful and thought provoking," particularly the notion of making parents an integral part of the medical information network.

Two of the trainers and one physician noted that the CMS guidelines are not universally accepted. They mentioned introducing other possible guidelines. Although this is a valuable and accurate comment, the presentation material was delimited to one concussion grading guideline and return-to-play criteria. The literature review in this project discussed three different guidelines, but the CMS guidelines were used in the presentation material for its simplicity and clarity. The reason one guideline was used in the material was to avoid confusion and too much information for the parents. The booklet and presentation manual state no one guideline is universally accepted and it is to be used in conjunction with a physician's clinical evaluation.

One physician also recommended reversing the content of the presentation manual and the booklet. The recommendation suggested that the presentation be shorter and that parents would have a more specific reference to take home. Although this recommendation

could be beneficial, the presentation of the material worked well and provided a significant difference between the pretests and posttests. The decision to present more extensive information during the presentation was based on the information provoking discussion topics and increase interest. Also, the brevity of the booklet was designed to give parents an easy, quick reference that they would feel comfortable using. If they are interested in learning more about a specific topic they can research additional references.

The presentation showed a significant educational value for the parents. They were interested in the information and appreciated having the reference booklet to take home for future use. Professionals felt the material was presented clearly, thoroughly covered information, and would be beneficial in the high school setting. Overall, this project proved to be educational for parents of high school football players and well received by professionals in related fields.

Chapter Five

Summary

In the United States, head trauma can be considered a major health problem with 130 to 150 people per 100,000 suffering head injuries annually. Roughly 75% of the head injuries can be classified as mild concussions (Mittl et al., 1994). Football, with the highest number of participants, ranks the highest among all high risk sports with 250,000 minor head injuries occurring annually (Gerberich et al., 1983). Within football, concussions are the fifth most frequently occurring injury (Kelly, 1996; Zemper, 1994) with 20% of high school football players suffering a concussion annually (Gerberich et al., 1983; Kelly, 1996).

A number of different guidelines have been developed for grading the severity of concussions and return-to-play criteria once an athlete has suffered a concussion. There is no agreement on one guideline; the Academy of Pediatrics, the American Academy of Sports Physicians, and the Olympic Committee endorse guidelines developed by the Colorado Medical Society. Although there is no agreement on one particular guideline for concussion classification or return-to-play criteria (Bloom, 1998; Cantu, 1998a), the guidelines can be extremely useful in conjunction with a physician's clinical evaluation.

Injury prevention is important in reducing the number of head injuries in football. Because of the mechanisms for sustaining concussions in football, the proper use of helmets and mouthguards is critical in decreasing injuries on the field. Helmets have been designed to reduce the number and severity of concussions sustained during football (Zemper, 1989). One study found numerous errors in the fitting of high school football helmets (McGuine & Nass, 1996). The researchers suggested that fitting the helmet solely at the beginning of the season was not adequate and that the fit needs to be maintained and monitored throughout the season.

Along with helmets, mouthguards are important for reducing the incidence of

concussions in sports (Chapman, 1993). Mouthguards are the most commonly used piece of equipment in all high risk sports (Jennings, 1990). Although mouthguards are worn to protect teeth, the main function of wearing a mouthguard is for shock absorption when an athlete receives a blow to the jaw, which is the most common mechanism for a concussion (Chapman, 1993). There are a variety of mouthguards available on the market, but understanding the role mouthguards play in injury prevention and the characteristics of mouthguards will help insure that the correct mouthguard is selected to meet the athlete's needs.

Parents are responsible for the health of their athletes and can play an important role in injury prevention when provided with the necessary information. Unfortunately, a national survey showed a lack of parental knowledge regarding brain injury risks in football (Goldhaber, 1993). One study showed less than 1% of parents were aware of the risk of severe brain damage associated with football, and 63% of parents believed football helmets could completely eliminate the risk of sustaining a head injury (Goldhaber, 1993). However, parents receive limited information regarding the risk of injury associated with football (Goldhaber, 1993).

The purpose of this project was to create an educational booklet and presentation manual for schools to use to educate parents about risks associated with concussion injuries in football and possible avenues of injury prevention. The material in the presentation manual and booklet included information regarding concussions, prevention of concussions, general guidelines for helmet fitting and mouthguards, guidelines for concussion grading, return-to-play criteria for athletes suffering from a concussion, and references for further reading and information.

To assess the educational value of the materials designed, the presentation was given twice to a total of 26 parents who were members of the Redwood High School Pigskin Club. The parents each completed pretests and posttests. A two-tailed t-test was conducted

on the pretest and posttest results from each presentation. A significant difference ($p < .05$) was found between the scores from both presentations. Twenty parents who did not attend a presentation read the reference booklet and completed the pretest and posttest. A two-tailed dependent t-test was also conducted on these results. A significant difference was also found between the parents' pretest and posttest scores. When assessing all the pretests and posttests, the parents improved on every question.

Professionals reviewed the presentation manual and booklet to assess their quality and content. The materials were distributed to two team physicians, two high school athletic administrators, and three high school athletic trainers. Overall, the professionals felt the material was comprehensive, professional, and valuable for parents of football players in the high school setting.

Conclusions

1. The significant difference found between the pretest and posttest scores for parents attending the presentation showed that the presentation was of educational value for the parents of high school football players.
2. The significant difference found between the pretests and posttest for parents reading the reference booklet showed that the booklet was of educational value for the parents of high school football players.
3. Professionals evaluating the presentation manual and booklet strongly agreed that information included in the presentation manual and booklet would be of educational value in the high school setting and was presented in a professional manner.

Recommendations

1. Freshman football parents knew less about concussion injuries and equipment in football than did parents of older high school football players. Perhaps this presentation should be directed toward all freshman football parents at the beginning of their first football season with the high school.

2. Many parents expressed interest in this presentation being given to the Redwood High School Football Team. Many parents felt the players may not fully understand the possible seriousness of a concussion and the avenues to prevent sustaining a concussion. The material could easily be adapted for high school football players.
3. The material could also be easily adapted to concussions in any sport. By eliminating the sport-specific focus, the presentation could be targeted towards parents with children participating in other high school athletic sports. This would help increase the number of parents attending each presentation and the education of all parents with children participating in high school athletics.
4. The material could also be adapted for high school football coaches as well as coaches of other contact sports. Coaches attend all practices and games and may be aware of injuries that an athlete sustains. Being well educated on mechanisms of injuries and possible outcomes could guide coaches in making appropriate decisions regarding athletes' health.
5. Research is continually being conducted regarding concussions. For this reason, information in the booklet and presentation manual should be updated bi-annually and appropriate changes made. If there is a significant findings in research the information should also be update, the booklet and presentation manual should also be updated at that time.

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Appendix A

Informed Consent

This project was approved by the

Human Subjects Institutional Review Board of San Jose State University

San José State
UNIVERSITY

College of Applied Sciences and Arts
Department of Human Performance
One Washington Square
San José, CA 95192-0054
Voice: 408-924-3010
Fax: 408-924-3053

Agreement to Participate in Research

A Project to Educate Parents on High School Football Concussion Issues

Responsible Investigator: Colleen Chelini, A.T.,C.

1. I have been asked to participate in a project to help educate parents on concussion issues related to high school football.

2. I will be asked to attend a presentation on concussions at Redwood High School. While at the presentation I will complete the pretest and posttest questionnaires

3. No foreseeable risks are associated with attending this presentation.

4. Benefits of attending this presentation may be learning more information on concussion issues related to football and what steps may aid in prevention of concussions.

5. If I can not attend the presentation, I agree to read the parents' booklet, complete the pretest and posttest questionnaires, and return materials to Colleen Chelini at 1154 Wilhemina Way, San Jose, CA, 95120.

6. No information will be published that could identify me individually. I understand results may be published identifying participants as member of the Redwood High School Pig Skin Club.

7. If there are any questions about the research, they may be addressed to Colleen Chelini at (408)268-5740. Complaints about the research may be presented to Greg Payne, P.E.D. at (408)924-3028. Questions about research, subjects' rights, or reasearch-related injury may be presented to Nabil Ibrahim, Ph.D. Acting Associate Vice President for Graduate Studies and Research at (408)924-2480.

8. Not participating in this study will not affect my standing with the Redwood High School Pig Skin Club.

9. Consent to participate in the study is given voluntarily. I understand I may refuse to participate in the study or an part of the study. I understand I am free to withdraw at any time from the study without prejudice to my relations with San Jose State University, Redwood High School, or any other participating institutions.

10. I have received a signed and dated copy of the consent form.

•The signature of a subject on this document indicates agreement to participate in the study.
•The signature of a researcher on this document indicates agreement to include the above named subject in the research and attestation that the subject has been fully informed of his or her rights.

Signature_____ Date_____

Researcher Signature_____ Date_____

San José State
UNIVERSITY

College of Applied Sciences and Arts
Department of Human Performance
One Washington Square
San José, CA 95192-0054
Voice: 408-924-3010
Fax: 408-924-3053

April 14, 1999

Dear Parent,

I am currently a graduate student at San Jose State University working to complete my master thesis. To complete my thesis, I need your help in conducting a project to educate parents on high school football concussion issues. The results of this study will help me determine if the enclosed booklet is educational.

Enclosed is a booklet on concussions, a pretest, a posttest, and an envelope. If you choose to participate in this project, please complete the pretest, read the booklet, then complete the posttest. Please refrain from reading the booklet prior to taking the pretest. The pretest and posttest should be returned to me in the postage paid envelope. You may keep the booklet as a future reference.

You should understand that your participation is voluntary and choosing not to participate in this study, or in any part of this study, will not affect your relations with San Jose State University or Redwood High School.

There are no foreseeable risks for participating in this study. You should benefit from participation by increasing your knowledge on concussion issues associated with high school football and what steps may aid in the prevention of concussions.

The results of this study may be published, but any information that could result in your identification will remain confidential.

If you have any questions about this study, I will be happy to talk with you. I can be reached at (408)268-5740. If you have questions or complaints about research subjects' rights, or in the event of a research related injury, please contact Nabil Ibrahim, Ph.D., Acting Associate Vice President for Graduate Studies and Research, at (408)924-2480.

If you choose to participate, I would like to thank you in advance for your help assisting me with my project.

Sincerely,

Colleen Chelini, A.T.,C.
Graduate Student

Appendix B

Educational Value Evaluation Form (pretest)

Pretest Questionnaire

1. An athlete could suffer a concussion without losing consciousness.

   T F

2. The primary reason for wearing a mouthguard is to protect one's teeth.

   T F

3. There is one standard guideline for concussion management.

   T F

4. The majority of all sport-related concussions are associated with football.

   T F

5. Every year, one in twenty high school football players suffers a concussion.

   T F

6. In football, quarterbacks are at the highest risk for sustaining a concussion.

   T F

7. Football helmets come with warning labels on them.

   T F

8. Signs and symptoms of a concussion include dizziness, dilating pupils, and ringing in the ears.

   T F

9. An athlete can return to play immediately following a concussion as long as there are no signs and symptoms of a concussion present.

   T F

10. An ideal mouthguard should cover both upper and lower teeth.

    T F

11. Once an athlete has sustained a concussion, the chance of having a second concussion is four times greater.

    T F

12. Second impact syndrome is a common result of sustaining a second concussion and cannot be prevented.

    T F

13. Post-concussion syndrome is when signs and symptoms of a concussion last longer than expected.

    T F

14. After a grade three concussion, an athlete may return to competition as soon as all symptoms have resolved.

    T F

15. There is no need to refit football helmets during the season, if it is fitted properly at the beginning of the season.

    T F

Appendix C

Educational Value Evaluation Form (posttest)

Posttest Questionnaire

1. The primary reason for wearing a mouthguard is to protect one's teeth.

   T F

2. There is one standard guideline for concussion management.

   T F

3. An athlete could suffer a concussion without losing consciousness.

   T F

4. Every year, one in twenty high school football players suffers a concussion.

   T F

5. Second impact syndrome is a common result of sustaining a second concussion and cannot be prevented.

   T F

6. In football, quarterbacks are at the highest risk for sustaining a concussion.

   T F

7. The majority of all sport-related concussions are associated with football.

   T F

8. Football helmets come with warning labels on them.

   T F

9. An athlete can return to play immediately following a concussion as long as there are no signs and symptoms of a concussion present.

   T F

10. Signs and symptoms of a concussion include dizziness, dilating pupils, and ringing in the ears.

    T F

11. Post-concussion syndrome is when signs and symptoms of a concussion last longer than expected.

    T F

12. There is no need to refit football helmets during the season, if it is fitted properly at the beginning of the season.

    T F

13. An ideal mouthguard should cover both upper and lower teeth.

    T F

14. Once an athlete has sustained a concussion, the chance of having a second concussion is four times greater.

    T F

15. After a grade three concussion, an athlete may return to competition as soon as all symptoms have resolved.

    T F

Appendix D

Educational Value Evaluation Answer Key

Questionnaire Answer Key

1. An athlete could suffer a concussion without losing consciousness.

   TRUE. Loss of consciousness is generally associated with a Grade 3 concussion.

2. The primary reason for wearing a mouthguard is to protect one's teeth.

   FALSE. The primary reason is for shock absorption to prevent concussions and fractures.

3. There is one standard guideline for concussion management.

   FALSE. There are several guidelines for concussion management.

4. The majority of all sport-related concussions are associated with football.

   TRUE. Football ranks the highest among all sports with minor concussions.

5. Every year, one in twenty high school football players suffers a concussion.

   FALSE. One in five football players suffers a concussion annually

6. In football, quarterbacks are at the highest risk for sustaining a concussion.

   FALSE. Quarterbacks are at the lowest risk for sustaining a concussion.

7. Football helmets come with warning labels on them.

   TRUE.

8. Signs and symptoms of a concussion include dizziness, dilating pupils, and ringing in the ears.

   TRUE.

9. An athlete can return to play immediately following a concussion as long as there are no signs and symptoms of a concussion present.

   FALSE. An athlete should be observed for at least a 20 minute period and be totally symptom free before being allowed to return to play.

10. An ideal mouthguard should cover both upper and lower teeth.

    FALSE. Mouthguards should cover the upper teeth.

11. Once an athlete has sustained a concussion, the chance of having a second concussion is 4 times greater.

    TRUE.

12. Second impact syndrome (SIS) is a common result of sustaining a second concussion and cannot be prevented.

    FALSE. SIS can occur when an athlete sustains a second concussion without the symptoms of a previous concussion having subsided and is completely preventable.

13. Post-concussion syndrome is when signs and symptoms of a concussion last longer than expected.

    TRUE.

14. After a grade three concussion, an athlete may return to competition as soon as all symptoms have resolved.

    FALSE. An athlete should be symptom free at least 2 weeks before returning to play

15. There is no need to refit football helmets during the season, if it is fitted properly at the beginning of the season.

    FALSE. Football helmet fit should be checked and maintained frequently.

Appendix E

Quality and Content Evaluation Form

Quality and Content

The following form is to assess the quality and content of the manual and reference booklet. Please rate the following on this scale: SA (Strongly Agree), A (Agree), N (Neutral), D (Disagree), and SD (Strongly Disagree). If you have no opinion, mark NO.

The booklet:

1. The booklet covered the material I expected.
   SA A N D SD NO
2. The information in the booklet was clear and easy to follow.
   SA A N D SD NO
3. The material in the booklet was presented in a professional manner.
   SA A N D SD NO
4. The booklet covered a wide range of related topics.
   SA A N D SD NO
5. The booklet would be educational for parents of high school or youth football players.
   SA A N D SD NO
6. The booklet is visually pleasing.
   SA A N D SD NO

The Presentation Manual:

7. The presentation manual covered the material needed to make the presentation.
   SA A N D SD NO
8. The presentation material was clear and easy to follow.
   SA A N D SD NO
9. The material in the presentation manual was of professional quality.
   SA A N D SD NO
10. The presentation manual provided reasonable background information.
    SA A N D SD NO
11. The presentation would be educational for parents of high school and youth football players.
    SA A N D SD NO
12. The presentation manual was visually pleasing.
    SA A N D SD NO

Please make any additional comments regarding the presentation and material covered:

Appendix F

Human Subjects Approval

San José State
UNIVERSITY

Office of the Academic Vice President
Associate Vice President Graduate Studies and Research
One Washington Square
San Jose, CA 95192-0025
Voice: 408-924-2480
Fax: 408-924-2477
E-mail: gstudies@wahoo.sjsu.edu
http://www.sjsu.edu

TO: Colleen Chelini
1154 Wilhemina Way
San Jose, CA 95120

FROM: Nabil Ibrahim,
Acting AVP, Graduate Studies & Research

DATE: April 12, 1999

The Human Subjects-Institutional Review Board has approved your request to use human subjects in the study entitled:

"A Project to Educate Parents on High School Football Concussion Issues"

This approval is contingent upon the subjects participating in your research project being appropriately protected from risk. This includes the protection of the anonymity of the subjects' identity when they participate in your research project, and with regard to any and all data that may be collected from the subjects. The Board's approval includes continued monitoring of your research by the Board to assure that the subjects are being adequately and properly protected from such risks. If at any time a subject becomes injured or complains of injury, you must notify Nabil Ibrahim, Ph.D., immediately. Injury includes but is not limited to bodily harm, psychological trauma and release of potentially damaging personal information.

Please also be advised that all subjects need to be fully informed and aware that their participation in your research project is voluntary, and that he or she may withdraw from the project at any time. Further, a subject's participation, refusal to participate, or withdrawal will not affect any services the subject is receiving or will receive at the institution in which the research is being conducted.

If you have any questions, please contact me at (408) 924-2480.

Appendix G

Letter of Appreciation

Redwood Pigskin Club
395 Doherty Drive
Larkspur, California 94939

May 4, 1999

Ms. Colleen Chelini
1154 Wilhelmina
San Jose California 95120

Dear Colleen,

Thanks so much for your presentation about head injuries and concussions in football. We really appreciate all of your time and the work involved to talk to us about the subject. Your presentation was very informative, and invaluable to each of us. The message you gave us is very clear: good, properly fitting helmets and mouth guards when worn properly are essential to reduce the number of head injuries. As parents each of us appreciate your reference booklet, Concussions in Football, and we'll keep it handy during the season.

The 1999 RHS Football season is about to begin, Spring Practice begins May15th. We are planning to get the information you've given us to each of our players, and to keep safety at the forefront of our checklist. We hope that you will have a chance to attend at least one of our home games over the next season. When you do, we hope you'll wear the enclosed Pigskin Club hat and T-shirt. When the schedule is finalized we'll send you a copy.

All of our best wishes to you in your academic and professional endeavors, your thesis work is a valuable contribution regarding concussions. We think that you can help not only football but all contact sports. Good luck!

Sincerely,

Cecilia Frazer

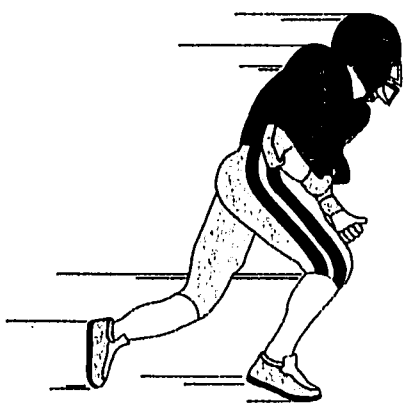
Cecilia (Cruickshank) Frazer
Secretary

Appendix H

Reference Booklet

CONCUSSIONS IN FOOTBALL

A PARENT'S REFERENCE



BY COLLEEN CHELINI, A.T.,C.
M.A., San Jose State University
B.S., University of California, Davis

TABLE OF CONTENTS

CONCUSSIONS

There are a number of different diagnoses associated with head injuries, including concussions.

A cerebral concussion is a condition, usually resulting from a violent jar or shock, resulting in immediate and transient impairment of neural function and the brain's ability to function properly. This type of injury can result in coordination, balance, and postural problems caused by swelling in the brain.

Signs and symptoms resulting from a concussion can vary in severity. Two conditions that can result after a concussion are post-traumatic syndrome and second impact syndrome.

- 130-150 people per 100,000 suffer head injuries annually.
- An estimated 75% of head injuries are classified as mild concussions.
- Signs and symptoms can include:
  - -unsteadiness
  - -headache
  - -dizziness
  - -disorientation
  - -unequal pupils
  - -amnesia
  - -loss of consciousness
  - -ringing in the ears
  - -personality changes
- Depending on signs and symptoms suffered, a physician should be consulted.

POST-CONCUSSION SYNDROME

Recovery time after a concussion varies with each patient.

Post-concussion syndrome is a condition where signs and symptoms of a concussion last longer than the expected amount of time.

Symptoms include:
- -continuous headache
- -poor concentration
- -mood changes
- -fatigue

Recovery could take 35 days or more. If symptoms persist, seek medical attention.

SECOND IMPACT SYNDROME

Second impact syndrome (SIS) is a condition resulting from sustaining a second concussion before symptoms from an initial concussion have subsided. Initially an athlete suffering from SIS will appear to have sustained a minor concussion, but within a few seconds to a few minutes the athlete may:
- -collapse to the ground
- -be semi-comatose
- -have dilating pupils
- -lose eye movement
- -suffer respiratory failure

SIS is extremely rare, but the outcome can be devastating. SIS has an estimated 50% mortality and 100% morbidity rate , but SIS is **PREVENTABLE** with proper treatment of an initial concussion.

If symptoms persist or increase in severity, seek medical attention **IMMEDIATELY**. Concussion symptoms can be signs of a more life-threatening head injury, including subdural hematoma, brain contusion, or hemorrhaging.

CONCUSSION GRADING SCALE

Concussions are generally graded on scales to help medical personnel assess the seriousness of the concussion. There are several guidelines found in the literature, but the guidelines established by the **COLORADO MEDICAL SOCIETY** (CMS) in 1990, revised 1991, have been endorsed by the American Academy of Pediatrics, American Academy of Sports Physicians, the NCAA, and the Olympic Committee. These guidelines are to be used in conjunction with a physician's clinical evaluation.

GUIDELINES FOR THE MANAGEMENT OF CONCUSSIONS IN SPORT **DEVELOPED BY** **THE COLORADO MEDICAL SOCIETY**	
GRADE 1	•Confusion without amnesia •No loss of consciousness •Remove from event pending on-site evaluation prior to return •Commonly referred to as "dinged" or "bell rung"
GRADE 2	•Confusion with amnesia •No loss of consciousness •Remove from event and disallow return •Monitoring of signs and symptoms over the next 24 hours by medical personnel or family with clearly written instructions
GRADE 3	•Loss of consciousness •Remove from competition and transport to appropriate medical facility for a thorough neurological exam, including a CT scan or MRI when indicated •Monitor until symptoms subside

RETURN-TO-PLAY CRITERIA

Deciding when an athletes should return to competition is crucial to avoid exacerbating their condition. There is no universal agreement on when an athlete should return to competition and this guideline, established by the **COLORADO MEDICAL SOCIETY**, is a recommendation to be used in conjuction with a physician's clinical findings.

RETURN-TO-PLAY CRITERIA **DEVELOPED BY** **THE COLORADO MEDICAL SOCIETY**	
GRADE 1	•Remove from competition •Examine immediately and every 5 min. for the development of amnesia or post-concussive symptoms at rest or exertion •May return to competition if amnesia or other symptoms do not appear after a 20 min. observation period
GRADE 2	•Remove from contest and disallow return •Examine frequently for evolving signs and symptoms •Re-examine the next day •May return to practice after one full week without symptoms
GRADE 3	•Transport from field by ambulance (with cervical spine immobilization if indicated) to nearest hospital •Thorough neurological evaluation •Hospital confinement if indicated by signs and symptoms •If findings are normal, instructions to family for overnight observation •May return to practice after two full weeks without symptoms
GUIDELINES DIFFER IF AN ATHLETE SUFFERS MULTIPLE CONCUSSIONS OF ANY GRADE IN ONE SEASON; CHECK WITH PHYSICIAN FOR RECOMMENDATIONS	

CONCUSSIONS IN FOOTBALL

The catastrophic sports registry cites sports as putting people at the greatest risk of incurring a severe injury per 100,000 participants. Football, with its large number of participants, ranks the highest among all sports with 250,000 minor head injuries occuring annually. Of all head injuries, concussions are the most common and the fifth most frequently occuring injury in football. Mild concussions are estimated to be 50% to 90% of all concussions, but many minor concussions go unreported. Roughly, 1 in 5 high school football players will sustain a concussion annually.

Concussions generally occur from helmet-to-helmet contact, helmet-to-knee contact, and helmet-to-ground contact. An estimated 68% of concussions result from impact to the head. Helmet-to-helmet contact accounts for 22% of the concussions sustained.

In 1972, spearing (head-first tackling) was banned from high school football. Many experts in the sports medicine field believe this has significantly reduced the number of head and neck injuries in high school football.

Many researchers have tried to establish correlations between concussions and other factors associated with football. No correlation has been established between sustaining a concussion and fatigue during games or practice. Although, the play the team is

- 63% of all sport related concussions are associated with football.
- 1 in 5 high school football players sustain a concussion annually.
- 50-90% of all concussions are mild concussions.
- No correlation has been found between sustaining a concussion and fatigue.
- 40% of athletes sustaining a concussion have suffered from a previous concussion.
- Quarterbacks are at lowest risk for sustaining a concussion.

running and the position the football player plays may relate to a player's risk of sustaining a concussion.

Fifty one percent of concussions occur during running plays, while only 22% and 17% occur during kicking and passing plays, respectively. Concussions more frequently occur while a player is making a tackle (44%) versus being tackled (32%). Special team members, receivers, defensive backs, and linebackers appear to have the highest risk for sustaining a concussion, while quarterbacks are at the lowest risk.

The initial symptoms suffered by the football players post-concussion are headaches (73%), confusion (62%), disorientation (46%), dizziness (44%), and memory loss (40%). Forty percent of athletes sustaining concussions have suffered a previous concussion. Once an athlete sustains an intial concussion, the chance of having a second concussion is four times greater.

HELMET FITTING:

- Clears eyebrows
- Ample space between face mask and nose
- Chinstrap centered and tight
- Jaw pads snug to face
- Ear holes aligned with ears
- Adequate coverage of posterior cranium
- Minimal helmet movement

FOOTBALL HELMETS

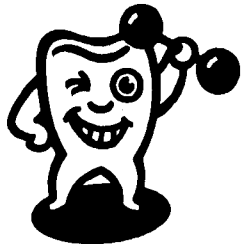
Helmets have been designed to reduce the number and severity of concussions sustained during football. Since 1974, the National Operating Committee on Standards for Athletic Equipment (NOCSAE) inspects football helmets to meet specific safety criteria and certify them. The National Federation of State High School Associations adopted the NOCSAE standards and requires helmets be certified by the NOCSAE, which has lead to a decrease in serious head injuries.

Having a helmet fitted properly is important, including ample air in the air-bladder to prevent helmet movement. In a Wisconsin school district, 1671 helmets were assessed for fitting errors. Seven criteria were established for fitting helmets properly and 3403 fitting errors were found. Multiple fitting errors were found in 62% of the helmets despite the availability of information on properly fitting helmets. Many of the helmet fitting errors were easily fixed with minor adjustments such as tightening the chin strap. Each helmet comes with specific fitting instructions and should be fitted properly and adequately maintained.

WARNING LABELS ON FOOTBALL HELMETS INCLUDE THE FOLLOWING INFORMATION:

Do not strike an opponent with any part of this helmet or face mask. This is a violation of football rules and may cause you to suffer severe brain or neck injury, including paralysis or death. No helmet can prevent all such injuries.

MOUTHGUARDS



Mouthguards are the most commonly used piece of protective equipment. Mouthguards provide wearers with protection against injuries to teeth, gums, and jaws. Through shock absorption, they also help protect athletes against face lacerations and head injuries, including concussions, jaw dislocations, and neck injuries. Mouthguards have been found to reduce dental injures by 90% or more.

Three types of mouth-guards are available on the market, with "boil and bite" being the most commonly used and custom fitted being the most effective in injury prevention.

CHARACTERISTICS OF A GOOD MOUTHGUARD

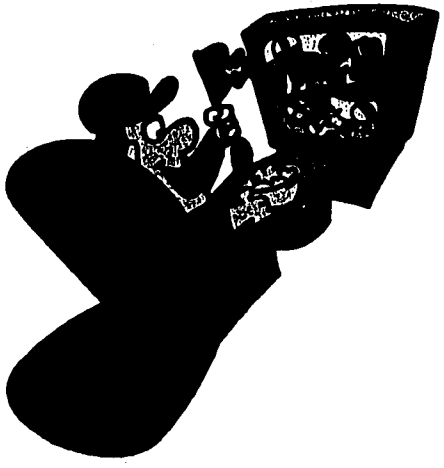
- Light, durable material
- Well fitted covering all maxillary teeth to at least the 2nd molar
- Ample thickness between surface of teeth to absorb shock
- Does not interfere with breathing patterns or communication
- To be worn during all contact practices and during competitions

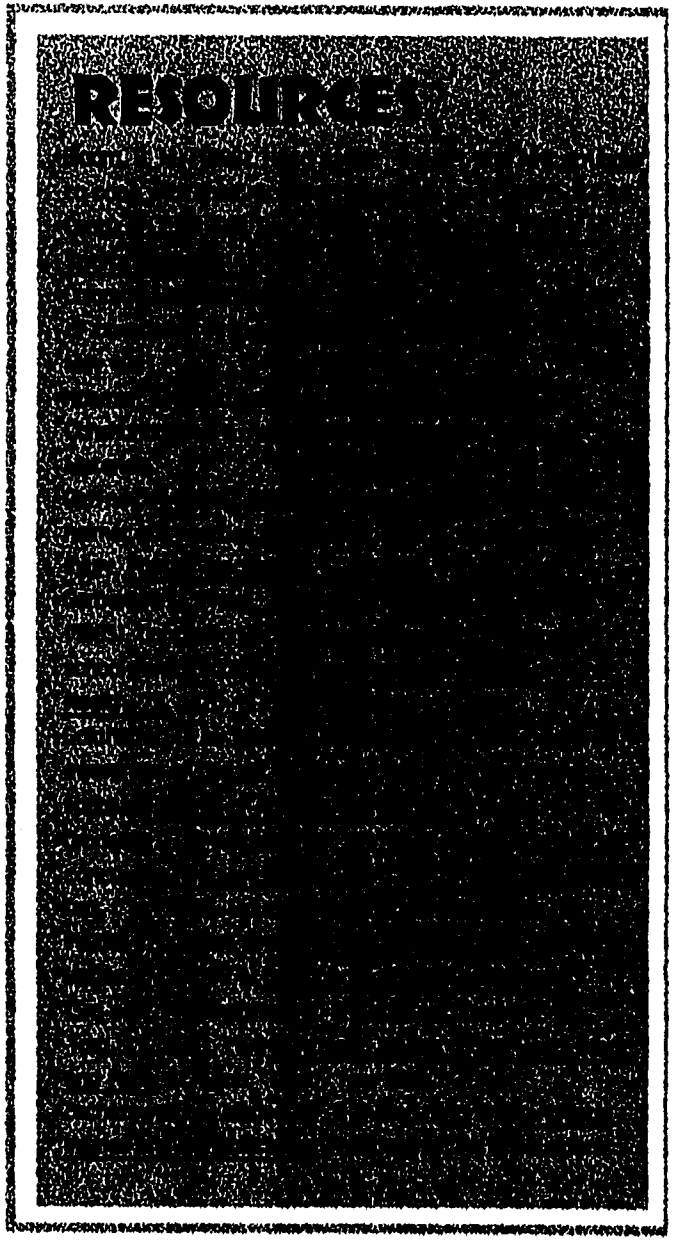
THE MOST EFFECTIVE MOUTHGUARD IS ONE THAT IS WORN!

CLEARANCE: RETURNING AN ATHLETE TO PRACTICE

Each school requires their own physical forms and waivers to clear an athlete to participate in a school sport. Schools also generally have their own requirements to allow an athlete to return to practice and games post-injury. Please check with your local school to insure all proper paperwork has been completed and information regaurding post-injury protocols has been received.

Understanding implications of injuries and following proper protocols will insure their child will be in good health to participate in school sports. In addition, communicating physician's post-injury recommendations with the coaching staff is highly recommended.





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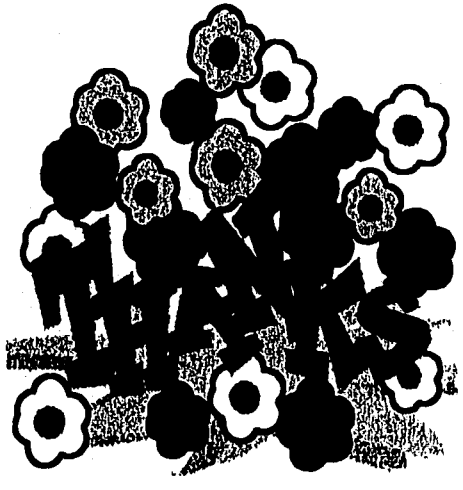

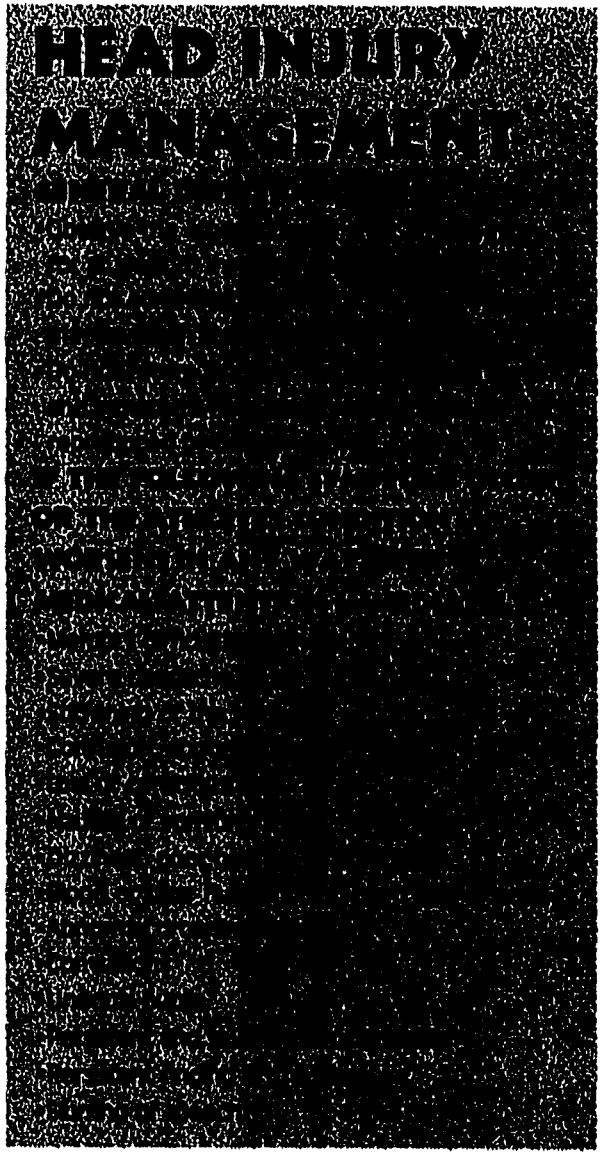

Appendix I

Presentation Manual

CONCUSSIONS IN FOOTBALL

PRESENTATION MANUAL

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WHY GIVE THIS PRESENTATION?

The National Operating Committee on Standards for Athletic Equipment (NOCSAE) states that head injuries account for 65% to 85% of all fatalities associated with football (Goldhaber, 1993). Physicians do not agree about when a player should return to play following a head injury (Bloom, 1998). Physicians' clinical findings are extremely important. Classification and return-to-play guidelines that physicians use may vary. A physician should clear a player before being allowed returning to play. However, as seen in professional sports, athletes can sometimes find a physician who is willing to clear them (Bloom, 1998). The discrepancy between treatments following initial injury and final results leaves athletes, coaches, parents, athletic trainers, and administrators in a state of confusion about when to allow an athlete to return to play. But, when dealing with the student athlete, one cannot be faulted for being too conservative. The results of a mistake can be catastrophic (Cantu, 1998a).

In high school football, parents play a significant role in decision making regarding an athlete's health. Although parents are instrumental in the decisions regarding their child's health, Goldhaber (1993) found parents were unaware of risks associated with playing football and misinformed about the safety of football helmets and their warning labels. There is a need for further education of parents regarding potential risks relating to football and head injuries (Cantu, 1998a, 1998b; Goldhaber, 1993).

The purpose of this presentation is to educate parents on concussions, prevention of concussions, general guidelines for helmet fitting, guidelines for concussion grading and return-to-play criteria for athletes suffering from a concussion, and references for further reading and information. This manual can be used in conjunction with the reference booklet to effectively

present this information to parents. This presentation is designed to help parents make educated decisions regarding their athletes' health and reduce the potential for school liability.

INTRODUCTION

In the United States, head trauma can be considered a major health problem with 130 to 150 people per 100,000 suffering head injuries annually. A majority of head injuries, about 75%, are classified as mild concussions (Mitti et al., 1994). Currently, the Congress of Neurological Surgeons defines a concussion as "a clinical syndrome characterized by immediate and transient post-traumatic impairment of neural function owing to mechanical force" (Zachazewski, Magee, & Quillen, 1996. p. 402). A common definition of a concussion is, "a traumatically-induced alteration in mental status" (Zachazewski et al., 1996, p. 402). Although a patient recovering from a mild concussion will usually recuperate without incident, morbidity and mortality can be associated with concussions (Kelly et al., 1991).

Uncertainty exists regarding prevention of concussions and when an athlete can return to play. Football safety is extremely important because concussions can alter an athlete's functional capacities. A significant number of high school football players suffer from concussions annually (Gerberich, Priest, Boen, Straub, & Maxwell, 1983). Because of the current body of literature on cerebral concussions and their possible long-term effects, physicians have become more conservative and rely on their clinical observations (Cantu, 1986). Unfortunately, physicians are not present at all athletic practices and events leaving coaches, athletic trainers, and parents responsible for assessment and treatment of many injuries, including concussions and assessing when an athlete may need further medical attention. Because coaches and athletic trainers may not see high school athletes on a functional level outside of practice, the parent's role in understanding possible athletic injuries and in assessing differences after injury is extremely important.

Concussions can yield severe consequences including permanent neurological damage and death. Proper use, fitting, and maintenance of football equipment are essential in maintaining safety on the field (McGuine & Nass, 1996). Mouthguards also reduce the severity of concussions by absorbing shock from blows to the head or chin (Chapman, 1993). Different positions on the football field put players at higher risks of sustaining a concussion (McKeag, Henderson, & McCoy, 1994) Players with a history of previous concussions may reduce future risk by assessing the position they play on the field and possibly changing their position. One important aspect of concussion prevention is education and understanding the guidelines to follow after sustaining a concussion to help reduce the risk of traumatic outcomes. Knowing reasonable guidelines for return-to-play can prevent further injury.

Parents are responsible for the health and care of their athletes and can play an important role in injury prevention when armed with the necessary information. Nevertheless, a national survey showed a lack of parental knowledge regarding brain injury risks in football (Goldhaber, 1993). Parents were questioned on their understanding of possible risks associated with playing football and their knowledge of warnings regarding football helmets. Each football helmet bears a warning label placed on the helmet by the manufacturer informing users of dangers associated with using the helmet. The label warns that striking an opponent with the helmet could result in serious consequences such as brain or neck injuries and could result in paralysis or death. The warning label also states that no helmet can prevent all injuries. Goldhaber (1993) found less than 1% of parents were aware of the associated risk of severe brain damage affiliated with football, and only 36.9% of parents knew about the warning labels on helmets.

HEAD INJURIES

"Head injury" is a generic term covering a wide range of injuries associated with the head. The term "head injury" can include diagnoses including skull fractures, cerebral hematomas, cerebral contusions, and concussions (Zachazewski et al., 1996).

Skull fractures are usually the result of tremendous focused force over a small area. They may be classified into four different categories: linear, commuted, depressed, and basilar. The actual location of a fracture site may vary. If the thickness of the skull is minimal, the fracture will usually occur at the site of impact. If the skull bone density is thick, the fracture site may occur at a nearby point where the skull is thinner and cannot handle the stress of the impact. A skull fracture should be immediately referred for a physician evaluation (Anderson & Hall, 1995).

Cerebral hematomas can be classified into two categories, epidural and subdural. Hematomas are a localized collection of blood. The classification of the hematoma depends on its location relative to the dura mater. If the blood pools outside of the dura mater, it is an epidural hematoma. If the blood pools within the dura mater, it is a subdural hematoma (Anderson & Hall, 1995; Zachazewski et al., 1996).

Epidural hematomas are extremely serious injuries requiring immediate medical treatment. If the hematoma is associated with a rupture of the meningeal artery, the hematoma will form relatively quickly due to the arterial pressure (Anderson & Hall, 1995). Although they account for 1% of all head injuries, epidural hematomas result in 5% to 15% of all fatal head injuries (Zachazewski et al., 1996). "However, even with early diagnosis and aggressive treatment, epidural hematomas carry a mortality rate of 8%" (Zachazewski et al., 1996, p. 400). Epidural hematomas are commonly

associated with skull fractures. They are usually treated surgically to relieve inter-cranial pressure within the skull.

Subdural hematomas account for 26% to 63% of all serious head injuries (Zachazewski et al., 1996). Generally, subdural hematomas are associated with venous blood vessel lesions, resulting is slower bleeding and formation of the hematoma. This can lead to delayed onset of signs and symptoms (Anderson & Hall, 1995). Subdural hematomas can be classified as simple or complicated depending on the involvement of the brain tissue in the injury. "The mortality rate of complicated subdural hematomas is 53%" (Zachazewski et al., 1996, p. 402). If surgery is indicated, early diagnosis is key since the mortality rate is less than 40% if the surgery is performed within 4 hours. The mortality rate increases to 80% to 90% if surgical intervention is performed over 4 hours postinjury (Zachazewski et al., 1996).

A cerebral contusion is a localized injury due to bleeding being dispersed throughout the brain tissue. A cerebral contusion can "occur in any portion of the cortex, the brain stem, or the cerebellum" (Zachazewski et al., 1996, p. 402). Patients with cerebral contusions will present with varied signs and symptoms including unconsciousness, headaches, dizziness and nausea. They should be evaluated clinically.

Concussions are an extremely common head injury. There are different classification guidelines regarding concussions used in conjunction with a physician's clinical findings. Significant literature can be found regarding concussions, the focus of the following literature review.

OVERVIEW OF CONCUSSIONS

There are a number of different diagnoses associated with head injuries, including concussions and second-impact syndrome (Cantu, 1998a). The Congress of Neurological Surgeons defines a concussion as "a clinical syndrome characterized by immediate and transient post-traumatic impairment of neural function owing to mechanical force" (Zachazewski et al., 1996. p. 402). For simplicity, a commonly used definition of a concussion is "a traumatically induced alteration in mental status" (Zachazewski et al., 1996, p. 402). Within the definition of a concussion, there are several different levels of injury classification. However, within the medical community, there is no agreement on one particular guideline for concussion classification or when a player can return to competition (Bloom, 1998; Cantu, 1998a).

Some physicians feel most guidelines are conservative and a good educational tool, but for physicians with substantial clinical experience with concussions, the guidelines are rarely followed. Physicians synthesize their experiences and knowledge to determine recommendations for their patients. There is also considerable debate as to whether brief loss of consciousness and posttraumatic amnesia should be symptoms placed in the more or less severe category. Some physicians have expressed concerns regarding the possibility of guidelines being used against them in the court room if the physicians do not follow them exactly (Fuerst, 1997).

Different levels of concussion injuries can occur. Several concussion classification systems are found within the literature (Zachazewski, et al., 1996). There is much discussion and debate over classification systems, and no single standard has been set for evaluation (Cantu, 1998a), although the Academy of Pediatrics, the American Academy of Sports Physicians, the

NCAA, and the Olympic committee endorse the Colorado Medical Society (CMS) guidelines, which will be the focus for this presentation.

The CMS (1991) established a useful grading system that can easily be applied, but not replace clinical evaluation by a physician. The CMS graded concussions into three levels. A grade one concussion is when an athlete sustains brief confusion without amnesia or loss of consciousness. Many athletes equate a grade one concussion with getting "their bell rung." Although these concussions are considered to be relatively minor, the athlete should be evaluated before returning to play. A grade two concussion is differentiated from a grade one concussion by amnesia accompanying the confusion. If post-concussion symptoms are persistent for more than 1 week, a CT scan or MRI is recommended. A grade three concussion is characterized by loss of consciousness. Athletes suffering from a grade three concussion should be referred to a medical facility as soon as possible for a full evaluation and possibly a CT scan or MRI.

POSTTRAUMATIC SYNDROME

Once a concussion is sustained, the patient could suffer from posttraumatic syndrome. Gronwall and Wrightson (1974) suggested that athletes who have sustained a concussion might experience decreased information processing speed. Research has found that recovery varies between patients. However, when symptoms last longer than the normal expected recovery time, the patient is suffering from posttraumatic syndrome. Postconcussion recovery time may take up to 35 days or more for symptoms to subside (Gronwall & Wrightson, 1974). Symptoms associated with postconcussion syndrome include continuous headaches, poor concentration, mood changes, and fatigue. Any athlete exhibiting these persistent symptoms should seek medical attention. In addition, a CT scan or MRI may be used to determine the severity of the injury. Athletes

suffering from a concussion need to have activity monitored until symptoms are resolved to avoid exacerbating the injury and increasing the risk for sustaining a second concussion (Cantu, 1998a; Zachazewski et al., 1996).

SECOND IMPACT SYNDROME

One traumatic outcome of a concussion can be second impact syndrome (SIS). After an initial concussion, an athlete generally exhibits postconcussion symptoms such as dizziness, headaches, and mental difficulties. SIS occurs when an athlete returns to play before these symptoms have resolved and sustains a second concussion. Although the second concussion may be minor, the next few seconds separate SIS from a standard concussion. An athlete suffering from SIS after the second concussion has been sustained will appear dazed as if suffering from a grade one concussion. However, within a few seconds to a few minutes, the athlete will collapse to the ground, become "semi-comatose with rapidly dilating pupils, loss of eye movement, and evidence of respiratory failure" (Cantu, 1998b, p.38).

SIS is rare. Only 22 cases of SIS were reported by the National Center for Catastrophic Sports Injury Research (Cantu, 1998b). Although rare, SIS can have catastrophic outcomes with 50% mortality rate and almost 100% morbidity rate. Refraining from contact sports until all symptoms have subsided is essential. Many athletes fail to report symptoms from a minor concussion because they fear being withheld from play. They do not realize the gravity of their condition. Educating athletes and parents in recognition of concussions and postconcussion symptoms is extremely important because SIS can be prevented (Cantu, 1998b).

INJURIES IN FOOTBALL

Head and neck injuries must be treated with great care because of possible traumatic outcomes after the injury. The catastrophic sports registry cites sports as putting people at the greatest risk of incurring a severe injury per 100,000 participants (Cantu, 1998a). Athletes have significant injury risk in many sports, including gymnastics, ice hockey, martial arts, wrestling, horse racing, car racing, and rugby. Football, with its high number of participants, ranks the highest among all sports with 250,000 minor head injuries per year (Gerberich et al., 1983).

In football, a variety of severe head and neck injuries can occur during practice and competition. Occasionally players die from these injuries. The most significant risk of catastrophic head and neck injuries for football players occurs during tackling, which includes spearing and head first contact (Cantu, 1998a; Heck, 1996). According to Drake (1996), between 1989 and 1993, an average of 2.4 high school football players died annually from football-related injuries, and 7.6 players suffered an injury causing irreversible damage to their spinal cord. There have been no fatalities directly related to football on the semi-professional or professional level since 1972, although an average of every 4 years, an athlete suffers permanent spinal cord damage (Drake, 1996).

Rule changes have reduced the number of severe head injuries. In 1972, head-first tackling, referred to as spearing, was banned from high school football in hopes of reducing the number of severe injuries. A study by Heck (1996) showed no reduction in spearing as a result of the rule change. Nevertheless, many authors feel the rule change has significantly improved safety for football players (Zachazewski et al., 1996).

Of all head injuries, the most common are concussions. In football, concussions are the fifth most frequently occurring injury (Kelly, 1996;

Zemper, 1994). In a concussion outcome study, McKeag et al. (1994), found 63% of all sport-related concussions were related to football. Rugby, basketball, hockey, and soccer followed at 6%, 6%, 5%, and 4%, respectively. Football concussions commonly stem from helmet-to-helmet contact, helmet-to-knee contact, or helmet-to-turf contact. According to Kelly (1996), 20% of high school students and 10% of collegiate players will suffer a concussion each season. On the basis of these statistics, an estimated 250,000 concussions occur each year in scholastic football players.

Football is a contact sport putting athletes at risk for head injuries. Unfortunately, many minor concussions are unreported because they are only thought of by players and coaching staff as a "ding" or "getting your bell rung," and not thought of as a concussion or a significant head injury. Mild concussions account for an estimated 50 to 90% of all concussions (Cantu, 1986; Cantu, 1998b). Most athletes will recover from a mild concussion without any complications. However, there is a chance for severe complications and lasting neurological deficits (Alves, 1991).

Alves (1991) designed a prospective study to address the effects associated with sustaining multiple concussions. He found that 55.8% of mild concussions were sustained during game competition . The concussion injury rates during games and in-season practices were not related to fatigue. During preseason training, when most teams have multiple practices per day, 49.2% of concussions sustained were during the final third of practice, which could be associated with fatigue or scrimmaging drills taking place at that time. However, Dickinson and Schramel (1966) found minimal correlation between concussion injuries and fatigue during activity. Alves (1991) found impact directed at the head accounted for 67.9% of all the injuries, with helmet-to-helmet contact being the most common at

22.1%. This finding was also corroborated by the findings of Dickinson and Schramel (1966).

Risks of sustaining a concussion increased depending upon the play the team ran and the position of the athlete on the field. Alves (1991) found 51.6% of concussions occurred during running plays, while only 17.2% and 22.6% occurred in passing and kicking plays, respectively. Concussions also appear to be more frequent (44%) when the athlete is making a tackle or blocking an opponent compared to being tackled or blocked (32%). The remainder of concussions (24%) occurred in practice or special team plays. Special team members, receivers, defensive backs, and linebackers seem to be at increased risk. However, this risk could be associated with the type of offense or defense the team ran and the number of plays each player executed.

Buckley (1988), using the NAIRS system over an 8 year period found running plays and blocking plays to be associated with the greatest risk. The highest risk for defensive players, especially defensive linemen, was associated with being blocked. Wide receivers were found to be at high risk while being tackled on passing plays The lowest risk found with offensive and defensive players was during tackling on passing plays. The quarterback is rarely at high risk of suffering a concussion, but risk increased while being tackled. Gerberich et al. (1983) found making a tackle to be the highest degree of risk at 43%. Only 23% of concussions occurred while being tackled. Blocking and tackling accounted for 20% and 10% of concussions sustained, respectively.

A concussion outcome study by McKeag et al. (1994) considered variables related to football concussions including player position, type of play, mechanism of injury, initial symptoms, and return-to-play. Linemen most frequently experienced concussions (27%), followed by wide receivers

(20%), running backs (16%), linebackers (14%), defensive backs (10%), special team players (8%), tight ends (4%), and quarterbacks (2%). Twice as many concussions (64%) occurred during games compared to practices (33%) and scrimmages (2%). The most commonly occurring mechanisms of injury were contact with an opponent (64%) or their own teammate (21%). Only 8% of concussions were sustained with ground contact, 1% occurred from equipment, and 6% from other mechanisms. The initial symptoms were headaches (73%), confusion (62%), disorientation (46%), dizziness (44%), and memory loss (40%). After the concussions were assessed, 67% of the athletes missing no games, and 21%, 7%, 4%, and 1 % of players missed one, two, three, or four or more games, respectively. More athletes were withheld from practice with 36%, 18%, 7%, 15%, 6%, and 18% missed zero, one, two, three, four, or five or more practices.

In assessing player performance patterns, Alves (1991) found the head injury group yielded a significantly different curve than the control group. The student controls and athletes sustaining orthopedic injuries showed improvements between the 24 hour and 5 day testing segments, but no further improvements in additional testing. The concussion group showed improvements between the 24 hour and 5 day testing periods, and between the 5 and 10 day testing periods. This timing seemed to coincide with athletes' complaints of symptoms. The 10 day and 12 week post-season results were the same between the three groups, with subjects appearing to show complete recovery after the concussion (Alves, 1991).

An athlete is four to six times more likely to suffer a concussion with a previous history of sustaining concussions. Dickinson & Schramel (1966) found 40% of the football players sustaining a concussion in their study had suffered a previous concussion.

RETURN TO PLAY

Gerberich et al. (1983) found 20% of high school football players would suffer from a concussion. The question of when an athlete should be allowed to return to play is crucial. There is no universal agreement regarding when an athlete should return to play after suffering from a concussion. The guidelines outlined by the CMS (1991) and Cantu (1986) for grading concussions also include return-to-play recommendations. Nevertheless, Cantu (1998a) stated that final decisions about return to play should be based on physicians' clinical decisions.

The CMS (1991) suggested return-to-play guidelines to complement their concussion grading system. If an athlete suffers a grade one concussion, the CMS believes they need to be removed from competition and observed for a 20 minute period. If, at that time, an athlete is asymptomatic during rest and exertion the athlete can return to competition. Players sustaining a second grade one concussion during the same day should be removed from competition and evaluated. The season should be terminated if or when a player suffers a third grade one concussion. Such a player should be held from contact sports for at least 3 months and can only return to contact play if asymptomatic at that time. With a grade two concussion, the athlete should be removed completely from competition and monitored for 24 hours noting any increase in symptoms of postconcussion syndrome that might indicate a more serious injury. The athlete should be withheld from competition 1 week after resolution of symptoms at rest and exercise. An athlete who suffered a second grade two concussion should be withheld from play for a month. Serious consideration should be given to ending the athlete's season. With a third grade two concussion, the athlete's season should be terminated. An athlete suffering a grade three concussion should be benched for a 1 month

period after resolution of symptoms and allowed to return to play only after being asymptomatic for 2 weeks during rest and exertion. A second grade three concussion should end the athlete's season, and serious consideration should be given to avoiding any future contact sports (Colorado Medical Society, 1991).

To be able to apply the preceding return-to-play guidelines, not only does there need to be accurate assessment and recognition of the concussion, but also the evaluator must rely on the athlete to assess symptoms. Litt (1994) reported on a 16 year-old football player who suffered from a subdural hematoma. Initially, the athlete suffered a minor concussion. With the presence of postconcussion syndrome, the athlete underwent a CT that resulted in normal findings. Seventeen days after the initial injury, the athlete reported no further postconcussion symptoms. The athlete then performed exertion tests to see if symptoms could be re-created. With the athlete reporting no increase in symptoms, he was cleared to return-to-play 30 days after the initial injury. The next game the athlete "collided with an opponent, ran to the sidelines, and began to deteriorate on the sidelines after complaining of dizziness" (Litt, 1994, p. 69). He was treated immediately by the emergency medical staff, rushed to the hospital, and underwent a burr hole craniotomy to treat the hematoma. The athlete stabilized and was released from the hospital 10 days postsurgery.

During a follow-up visit 4 months postsurgery, the athlete admitted no cessation of symptoms after the first concussion. The symptoms suffered by the athlete were consistent with second impact syndrome and included headaches, sleeplessness, and poor concentration. Other patients suffering from similar symptoms have a 74% mortality rate and only an 8% chance for a successful recovery. Symptoms generally suffered after a concussion relate to the area of the brain that has sustained the injury and

lesion (Litt, 1994). Other cases have also been cited where athletes feel the pressures to compete again, so they play with cerebral symptoms from concussions, not realizing they could be seriously jeopardizing their health (Cantu, 1998b).

Although general guidelines have been established for return-to-play criteria, they are based on the honesty of the athlete during assessment. Making sure athletes are fully recovered from an initial mild head injury is essential in preventing injuries that could lead to devastating circumstances. Litt (1994) recommends neurological testing to aid in qualitatively assessing an athlete's mental status postconcussion.

INJURY PREVENTION

Injury prevention is essential in maintaining safety on the football field. In preventing catastrophic injuries in football, assuring properly fitted equipment is extremely important (Mueller & Blyth, 1995). This is particularly true for the helmet. Concussions are usually the result of the head contacting another helmet, the ground, an opponent's knee, or taking a blow to the jaw (Chapman, 1993; Kelly, 1996). Because of the mechanisms for sustaining concussions, the proper use of helmets and mouthguards is critical in maintaining the health and safety of football players.

THE HELMET

Among other things, helmets have been designed to reduce the number and severity of concussions sustained during football (Zemper, 1989). Although the National Football League (NFL) has recently celebrated its 76th anniversary, football helmets have been mandatory equipment for just over 50 years in the NFL and scholastic programs (Gaffney, 1995). Since its creation in early 1896 at Rutgers University, the football helmet has undergone numerous changes and advancements to aid the protection of participants (McWhorter, 1990).

Although there have been numerous changes in the football helmet's construction since its inception, there have been few changes since the 1970's (Gaffney, 1995). Even though there has not been significant change in the helmet to increase safety, manufacturers and researchers note the importance of properly fitting and maintaining the helmet to maximize its head protection capabilities (Cantu, 1998b). In addition, through prolonged use, the suspension webbing can be stretched, reducing the distance between the helmet and the head, and increasing the potential risk for sustaining a concussion. The padding within the helmet can also deteriorate

causing a decrease in thickness (Bishop, Norman, & Kozey, 1984). This decrease in distance between the helmet and the head decreases the amount of protection the helmet will provide. (McGuine & Nass, 1996).

To provide standardized maintenance of football helmets, the National Operating Committee on Standards for Athletic Equipment (NOCSAE) was founded in 1969. A standard criteria for football helmet safety was established in 1973, and the NOCSAE began testing helmets to meet their standards in 1974. By 1978, the NCAA required all helmets to meet the NOCSEA standards. By 1980, the National Federation of State High School Associations also adopted the NOCSEA's standards (Mueller, 1995). There has been a decrease in serious head injuries since the NOCSAE established its criteria for certifying protective equipment (Bishop et al., 1984; Zemper, 1994).

In professional and collegiate settings, many teams have equipment managers responsible for maintaining equipment and insuring proper equipment fit. In the high school setting, where equipment managers and athletic trainers are rare, fitting of football helmets is left to the coaching staff and the athletes (McGuine & Nass, 1996). According to McGuine and Nass (1996), 63% of Wisconsin high school football helmets were fitted by coaching staff, 25% were fitted by athletes, and 12% were fitted by others including athletic trainers or equipment managers. Results of the study showed a significantly greater number of fitting errors when the players or coaches fit helmets compared to other professionals. Many coaches admitted knowing very little about helmet fitting, and McGuine and Nass (1996) suggested that knowledge of fitting helmets for many coaches stemmed from wearing helmets during their own playing careers with no direct training.

There is no standard for fitting football equipment other than the information provided to athletes by the manufacturers. McGuine and Nass (1996) established seven criteria for proper football helmet fitting from their research. "The seven fitting criteria included:

1. 2.54-cm (1 in.) spacing above eyebrows,
2. 5.08-cm (2 in.) minimal clearance from the nose to the face mask,
3. chinstrap centered and taut,
4. jaw pads snug to the face,
5. ear holes aligned with the ears,
6. adequate coverage of the posterior cranium, and
7. minimal shell movement anteriorly or posteriorly with exterior pressure" (p. 84).

The study showed that in assessing 1671 helmets, 3403 fitting errors were found. The researchers found 62% of the helmets assessed had multiple fitting errors despite available literature on proper fitting of the football helmet. Overall, only 15.4% of the helmets were fitted properly. The percentage of helmets found with one or two errors and helmets found with four or more errors were 47.2% and 15.4%, respectively.

Many of the helmets found with one or two errors could easily be fixed with slight adjustments. Some of these errors could be fixed by tightening the chinstraps, inflating the bladders in the helmets, or placing the appropriate sized jaw pads in the helmet. Some of these corrections made the helmets feel uncomfortable, and athletes were found to release air out of the helmet's bladder or loosen the chinstrap to increase their comfort (McGuine & Nass, 1996). For this reason, McGuine and Nass (1996) suggested that fitting the helmet once at the beginning of the season was not adequate. Monitoring helmet fit throughout the season is necessary to maintain the proper fit. Zachazewski et al. (1996) suggested that air

bladders in the helmet need to be monitored on a daily basis to insure proper fit.

Helmet fitting errors were found to be associated with the person responsible for fitting the helmets, and the number of errors were also associated with the athlete's class level within the school. Freshman were found to have the highest number of fitting errors with an average of 2.54 errors per helmet, followed by sophomores, juniors, and seniors with 2.03, 1.81. and 1.80 errors found per helmet, respectively. Some errors could be attributed to freshman having the last choice for equipment (McGuine & Nass, 1996). Although schools would like to have a large selection of equipment, they have limited budgets. A second reason for the high number of fitting errors was helmets being too large for freshman, even when the smallest helmet is fitted on the smallest player (McGuine & Nass, 1996).

Although fitting errors due to human error can lead to injury, some helmets may be predisposed to increasing one's risk of sustaining a concussion. Zemper (1994) found a significant difference in the concussion occurrence rates between different brands and models. Although Zemper (1994) suggested more on-field investigation must be conducted, the quality and effectiveness of equipment used is extremely important.

Athletic equipment is made to protect athletes from possible injury during play. Although protective equipment cannot eliminate injury, it helps distribute forces to avoid serious injury. Although some protective equipment may be superior to others, the equipment should be used to its full potential. The purpose and role of the equipment must be clearly explained to the user. The equipment must be fitted properly and adequately maintained (Cantu, 1998b; Zachazewski et al., 1996; Zemper, 1994).

THE MOUTHGUARD

Mouthguards are now the most commonly used piece of protective equipment in contact sports (Jennings, 1990). These sports include ice and field hockey, lacrosse, rugby, football, boxing, soccer, basketball, and wrestling (Kerr, 1986). Mouthguards provide wearers with protection not only against injuries to teeth, gums, and jaws, but help protect athletes against face lacerations and head injuries, including concussions and dislocations, and neck injuries through shock absorption (Jennings, 1990; Kerr, 1986). The protection can be attributed to the mouthguard increasing the distance between the mandibular condyles and the skull. This helps decrease the force distribution after impact (Jennings, 1990). By absorbing shock sustained by the jaw during impact, the number of concussions can be reduced. This is extremely important because the most common cause of concussions in sports is a blow to the jaw (Chapman, 1993).

Research into the benefits of mouthguards came to the forefront in 1962 when 25 to 30% of injuries in football were associated with dental injuries. Researchers have found a 90 to 100% reduction in dental injuries when athletes wear mouthguards during contact play (Jennings, 1990). According to Kerr (1986), Heintz 1982 stated before the requirement of mouthguards in football, 50% of injuries were related to the mouth and face. After the initiation of the new rule, the injury rate for facial injuries dropped to less than of 1% of injuries in high school and collegiate football.

Because of their ability to absorb shock, mouthguards provide protection from fractures, dislocations, and concussions . To be able to provide this type of protection, the mouthguard must fit properly and cover the surface area of all the teeth. Mouthguards should be made of durable, light material that is easy to maintain. It is extremely important that mouthguards are comfortable to wear and not interfere with breathing or

communication during play. In addition, mouthguards must be made affordable so they are easily accessible to all participants (Jennings, 1990; Kerr, 1986).

Currently, there are no standards for the construction of mouthguards, but Scott et al. (as cited in Greasley & Karet, 1997) has established current practices and described the following suggested characteristics. The mouthguard should:

1) enclose the maxillary teeth to the distal surface of the second molars.
2) be 3 mm thick on the labial aspects, 2 mm on the occlusal aspect and 1 mm on the palatial aspect.
3) have the labial flange extend within 2 mm of the vestibular reflection.
4) have the palatial flange extend about 10 mm above the gingival margin.
5) round the edge of the labial flange in cross section and the palatial edge should be tapered. (p. 31)

There are several different types of mouthguards available on the market. Athletes can choose from custom made, factory-molded, and self-molded (boil and bite) mouthguards. Most mouthguards cover the maxillary teeth, but double mouthguards protecting both upper and lower jaws are also available. As the literature shows, mouthguards are essential in injury prevention, and some mouthguards are more effective than others in overall performance during competition (Greasley & Karet, 1997; Jennings, 1990; Kerr, 1986).

Custom-made mouthguards have been shown to be the most effective in injury prevention (Jennings, 1990; Kerr, 1986). Custom mouthguards meet all the criteria of acceptable standards according to Scott

et. al. and meet the players' concerns (Kerr, 1986). Although custom mouthguards are more expensive than over-the-counter products, "the cost-benefit ratio clearly shows they are a worthwhile investment. Numerous studies have shown that they reduce the incidence, severity, and extent of orodental injuries" (Chapman, 1993, p. 197).

Self-molded mouthguards are the most commonly used mouthguards in contact sports. The popularity of the self-molded mouthguards is likely due to the affordable price and accessibility of the mouthguards to the general public (Jennings, 1990). Self-molded mouthguards can be purchased in sporting good stores and easily fitted. The player, coach, or athletic trainer molds them by dipping the mouthguard into hot water to soften the plastic and then fitting it onto the maxillary teeth of the athlete. Although self-molded mouthguards aid in injury prevention, Greasley et al. (1998) found custom-made mouthguards perform better than the self-molded mouthguards. Concerns have been cited regarding the thinning of the self-molded mouthguards during the fitting. The molding process might thin the mouthguard below acceptable standards and may reduce the protection afforded (Greasley & Karet, 1997).

Self-molded mouthguards may be a valuable option for young children who are still growing. With growth, mouthguards will need to be replaced every year or two to maintain proper fit. Wearing over-the-counter, self-molded mouthguards is reasonable because injury risk increases with age. At young ages, the chance for sustaining an injury is relatively low, so the self-molded mouthguard would be suitable and is much safer than wearing no mouthguard at all (Chapman, 1993). "It is far more likely that a player will continue to wear a gum shield if he starts early in life" (Jennings, 1990, p. 164).

Generally, factory-molded and bimaxillary mouthguards are not considered to be an ideal choice in protection. Factory-molded mouthguards often fit poorly and are usually held in place by clenching the teeth. This can cause difficulties with breathing and communication, and probably discourage an athlete from wearing the mouthguard regularly (Chapman, 1993; Greasley & Karet, 1997; Jennings, 1990). Factory-molded mouthguards have also been found to dislodge during contact and possibly cause airway obstruction leading to respiratory distress. They should never be recommended for use (Chapman, 1993; Jennings, 1990). Although bimaxillary mouthguards are available and provide necessary protection, they significantly limit breathing and communication when in place. Therefore, these mouthguards have been deemed unacceptable for use during competition (Greasley & Karet, 1997).

One important way to increase mouthguard use during practice and competition is to educate athletes, coaches, athletic directors, parents, and physical education teachers on the role mouthguards play in injury prevention. Jennings (1990) found that only 79% to 88.4% of rugby players believed that mouthguards provided protection against injury. Very few of them realized the role mouthguards play in the reduction of sustained head injury. "Parents have the biggest influence on instigating the use of gum shields at an early age. Therefore, it is important for the parents to be well informed" on the role mouthguards play in injury prevention (Jennings, 1990, p. 165).

PARENT EDUCATION

High risk contact sports put participants at a greater risk for injury. At the high school level, athletes, physicians, athletic trainers, coaches, athletic directors, administrators, and parents are responsible for making educated decisions regarding an athlete's ability to safely participate in the sport. Numerous authors, including Mueller (1991), Goldhaber (1993), and Glassman (1996) cite the importance of injury prevention in preventing concussions and catastrophic outcomes. Although prevention is essential, The National Youth Sports Safety Foundation (NYSSF), a nonprofit educational research organization, noted various barriers in implementing injury prevention in youth football. Barriers include misinformation; attitudes of athletes, coaches, administrators, and parents; poor dissemination of information; lack of education; and inadequate injury surveillance. The NYSSF believes many injuries can be prevented through education (Glassman, 1996).

In the high school setting, parents play a pertinent role in decision making regarding their child's health. Yet, Goldhaber (1993) found parents have little knowledge concerning head injuries associated with football, the helmet's role in the protection for head injuries, or the overall risks associated with playing contact football. In a sample survey of parents with children currently or recently involved in high school football, "546 (54%) of parents mentioned knee injuries and 406 (40%) mentioned broken bones, hardly any parents (less than 1%) mentioned severe brain damage as being associated with playing high school football" (Goldhaber, 1993, p. 307). Even when parents were prompted on the possibility of severe brain injury, only 25% considered it to be an injury associated with football. Along with the assumption that severe brain injuries are not associated with football, 80% of parents believed helmets almost completely negated the possibility

of severe brain injury, 69% believed helmets completely eliminated the possibility of concussions, and 29% believed helmets prevented the possibility of sustaining a broken neck. These findings on parents' beliefs vary greatly with the findings of Gerberich et al. (1983) that one in five high school players will suffer from a concussion.

Goldhaber (1993) also found parents received little information on the risks associated with football. Eleven percent of parents had received written information, which was generally either from permission slips or waivers from the high school, from newspapers, or from television segments. Helmets are labeled with a warning that states, "Do not strike an opponent with any part of this helmet or face mask. This is a violation of football rules and may cause you to suffer severe brain or neck injury, including paralysis or death....No helmet can prevent all such injuries" (Goldhaber, 1993, p. 309). Goldhaber (1993) found 0.5% of parents had received information regarding possible brain injury from the football helmet's warning labels. Also, 27.6% of parents thought a helmet could completely prevent brain damage and only 36.9% of parents were aware of the presence of warning labels on the helmets (p. 307). Of the parents who were aware of the warning label on the football helmets, 81.8% of the parents did not know what the label said, and only 2.2% knew that it mentioned the risk of severe brain injury.

Goldhaber (1993) cited literatures suggesting the more familiar athletes or parents are with a piece of equipment, the less likely they are to associate dangers with using the product. This practice is even more common with teenage males because they are more willing to partake in risky activities and disregard safety warnings. Most educational information regarding football safety is directed towards coaches and players, yet parents are responsible for making educated decisions regarding their child's

safety. There is no evidence that players who are educated about possible risks associated with football share that information with their parents. The results of this survey showed few parents received information regarding risks associated with football from their children.

With access to current research and NOCSAE testing and information regarding risks associated with football, helmet manufacturers should take an active role in educating parents. Through written materials, including brochures, video tapes, and educational seminars, manufacturers can play an active role in educating participants so appropriate decisions can be made regarding safety of participants. Coaches, school administrators, and athletic trainers need to play an active role in disseminating the information to parties involved (Goldhaber, 1993).

REDUCING LIABILITY

Catastrophic head and neck injuries in football rarely occur. When they do, there is likely to be a lawsuit holding the high school administrators, medical staff, coaches, and parents responsible (Heck et al., 1994). Athletes and parents often will not admit an accident is the result of bad luck or judgment. They feel someone else is responsible for the outcome and should take financial responsibility (Granger, 1996). Athletic departments need to take the necessary steps by establishing risk management programs to reduce their exposure in lawsuits as most settlements top 1 million dollars (Granger, 1996; Heck et al., 1994).

Heck et al. (1994) addressed concerns including legal considerations, liability insurance, general law suits against athletic staffs, and defenses used in lawsuits. An important part of protecting against potential liability is understanding who can be held accountable for what and the legal terms associated with lawsuits. A tort is "a civil wrong, other than breach of contract, of which the court will provide a remedy in the form of an action for damages" (Heck et al., 1994, p. 128). Someone is negligent when the standard of care or conduct is below limits set by established law, which is usually guided by how a prudent person in a similar situation would act. Gross negligence is being negligent and showing no concern for the situation. Willful, wanton, or reckless negligence is intentionally acting in complete disregard for safety. Only six states recognize contributory negligence. However, in these states, contributory negligence is a strong defense because if plaintiffs are responsible for any of their own injuries due to their own particular actions will not receive any damages in a settlement.

The states not recognizing contributory negligence have replaced it with comparative negligence. Comparative negligence is assessing damages in a case relative to the amount of fault associated with each person in the

injury. Plaintiffs releases rights to collecting damages if they have willingly exposed themselves to a known risk associated with an activity. The player or guardian assumes the risk. Some states do not recognize assumption of risk or associate it with comparative negligence.

Informed consent is when, prior to any treatment or involvement in a procedure, the person knowingly and intelligently has given consent to participate in an activity. Finally, joint and several liability is when "the defendants are responsible together and individually for damages" (Heck et al., 1994, p. 129). This means that the full settlement can be collected from defendants regardless of their percentage of fault in the accident.

Lawyers tend to target lawsuits against coaches, schools, and athletic associations (Tally, 1985). Five of the most common areas focused on for litigation are breaches of duty by an individual include failing to give adequate instruction, failing to provide appropriate equipment, scheduling inappropriate opponents in competition, poorly supervising, and providing improper emergency protocols (Heck et al., 1994). In Wissel v Ohio High School Athletic Association, a quadriplegic high school football player sued his coaching staff citing they did not inform him of proper tackling techniques, the use of proper protective equipment, and understanding the warning labels on football helmets. In Gerrity v Beatty, the school district was brought to court charging the school district had not provided the athlete with a properly fitting football helmet. In Low v Texas Tech University, the coaching, management, and medical staffs were charged with failing to provide proper protective equipment. In Vendrell v School District No 26C, the coaching staff was alleged negligent in not safely assessing the experience of a freshman football player on the varsity team and his ability to compete safely during varsity competition. In Jarreau v Orleans Parish School Board, the coaching staff and school broad were cited for allegedly

not taking proper injury procedures, delaying medical care and diagnosis for an injured athlete (Heck et al., 1994). In Baker v Briarcliff School District, the coach was cited for failing to protect his athlete from increased risk of injury and for failing to monitor her wearing a protective mouthguard during practice (" Field hockey", 1995).

Administrators, coaches, and medical staff use different defenses in suits brought against them. In "several states, by statute, confer total or limited immunity to schools or teachers while acting in the normal scope of their duties" (Heck et al., 1994, p. 132) is a strong defense. Another common defense is the assumption of risk by the athlete and the athlete's family as an inherent part of the sport. So, it is extremely important that athletes and parents of minors are well informed of risks associated with their sport, especially football, by using videotapes, seminars, and assumption-of-risk forms. These steps will help protect schools and clubs during litigation. Also, using a documented source, such as videotape that can be reviewed by a jury to show that athletes and parents were informed of risks, is strong evidence in a legal defense. Administrators to protect themselves in court have also used waivers releasing parties from liability. Providing educational safety seminars for parents of high school players to inform them of risks associated with playing football and other contact sports and documenting all information distributed is essential in establishing a good risk management program (Granger, 1996; Heck et al., 1994).

SUMMARY

Roughly 1,500,000 junior and senior high school players participate in football (Lucenko, 1996). Some 250,000 minor head injuries occur annually, ranking football the highest of all sports in the number of concussions sustained (Cantu, 1998a). Many of these concussions, minor head injuries, and traumatic outcomes can be prevented (Cantu, 1998b; Glassman, 1996; Goldhaber, 1993; Jennings, 1990; Kerr, 1986; Mueller & Blyth, 1995).

Mild concussions are the most commonly occurring type of concussion (Cantu, 1986; Cantu, 1998b). Proper diagnosis and monitoring can prevent traumatic outcomes such as SIS from happening and patients sustaining permanent neurological damage (Cantu, 1998b; Gronwall & Wrightson, 1975). Understanding concussion grading guidelines and return-to-play criteria along with a physician's clinical evaluation is extremely important for preventing further injury.

The helmet also plays a significant role in reducing the number and severity of concussions during football (Zemper, 1989). A helmet must be fitted properly to ensure an athlete's safety. Unfortunately, at the high school level, McGuine and Nass (1996) found numerous fitting errors in high school football helmet fitting. Also, people did most of the fitting with little education on how to properly fit a football helmet.

Mouthguards are extremely important in preventing fractures, dislocations, and concussions because of their ability to absorb shock from a blow to the head or jaw. With the use of mouthguards, dental injuries were reduced 90% to 100% in contact sports (Jennings, 1990). Mouthguards are required in high school and collegiate football, but there are no stipulations on the type of mouthguard required (Kerr, 1986). Custom mouthguards have been found to provide the best protection from incidence and severity of injuries during contact (Chapman, 1993; Jennings, 1990; Kerr, 1986).

In high school, parents are responsible for the health of their minor children. Goldhaber (1993) found parents to have little knowledge regarding head injuries in football and risk of concussions. They were also unaware of warning labels on football helmets informing users of the potential risk of severe brain damage. Parent education is extremely important to reduce the overall risks associated with football.

Parent education can help ensure helmets and mouthguards are fitted properly and that injured athletes follow reasonable guidelines for return-to-play along with a physician's diagnosis. By understanding issues associated with head injuries in football, educated decisions can be made regarding an athlete's health which could, in-turn, reduce the number and severity of injuries sustained.

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1

Concussions In Football

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2

Outline

- *Introduction*
- *Concussions*
- *Post-Concussion Syndrome*
- *Second Impact Syndrome*
- *Concussion Grading Scale*
- *Return-to-Play Criteria*
- *Concussions in Football*
- *Football Helmets*
- *Mouthguards*
- *Conclusion*

3

Topic Introduction

- ***There are a number of different diagnoses associated with head injuries, including concussions.***
- ***Coverage of high school football games by physicians and athletic trainers is not uniform.***
- ***Athletes, coaches, administrators and parents need to take the necessary steps when an athlete has sustained a concussion.***

4

Topic Introduction

- *Parents*
  - *Interact with athletes on a daily basis*
  - *Familiar with functional capacities*
  - *Responsible for athlete's health*
- ***Best defense against traumatic outcome from concussions is prevention***
  - *Helmets*
  - *Mouthguards*
  - *Concussion Education*

5

Concussions

- ***Concussions are a condition usually resulting from a violent jar or shock, resulting in immediate and transient impairment of neural function and the brain's ability to function properly***

- *Concussions can cause a swelling in the brain resulting in problems with:*
  - *coordination*
  - *balance*
  - *posture*

6 ☐ *Signs and Symptoms*

- *Unsteadiness*
- *Headache*
- *Dizziness*
- *Disorientation*
- *Unequal pupils*
- *Amnesia*
- *Loss of consciousness*
- *Ringing in the ears*
- *Personality changes*

7 ☐ *Post-Traumatic Syndrome*

- *Decrease in processing speed*
- *Symptoms last longer than expected*
  - *continuous headaches, poor concentration, mood changes, fatigue*
  - *can take 35 days or more to recover*
- *An MRI or CT scan may be indicated*
- *Activity should be monitored until signs and symptoms are completely resolved*

8 ☐ *Second Impact Syndrome*

- *SIS is rare, but can have catastrophic outcomes*
- *Can occur when sustaining a second concussion prior to resolving of symptoms from first concussion*
- *The first few seconds after the second concussion differentiate SIS from a normal concussion*

9 ☐ *Second Impact Syndrome*

- *Initially after the second concussion the athlete appears to be dazed as if suffering from a grade 1 concussion.*
- *However, within a few seconds to a few minutes, the athlete will:*
  - *collapse to the ground*
  - *become semicomatose*
  - *have dilating pupils*
  - *lose eye movement*
  - *have evidence of respiratory failure*

10 ☐ *Second Impact Syndrome*

- *SIS is extremely rare with only 22 cases diagnosed by the National Center for Catastrophic Sports Injury Research.*

- *Although rare, the outcome has a 50% mortality rate and almost 100% morbidity rate*
- *SIS is completely preventable when proper protocols are followed*

11 ☐ *Case Study*

- *A 16-year-old suffered from a minor concussion with post-concussion syndrome.*
- *After 17 days, the athlete reported no further symptoms at rest or exertion.*
- *He was cleared to return to play 30 days after the initial injury.*

12 ☐ *Case Study*

- *The next game, he collided with an opponent, ran to the sidelines, and began to deteriorate on the sidelines after complaining of dizziness.*
- *He was treated immediately by medical staff and rushed to the hospital.*
- *He immediately underwent surgery for a subdural hematoma.*
- *He stabilized and was released from the hospital 10 days after surgery.*

13 ☐ *Case Study*

- *During a follow-up visit, the athlete admitted no cessation of symptoms after the first concussion.*
- *Other cases have been noted when athletes returned to competition too soon based on pressures to compete, not realizing the consequences of their actions.*
- *Other patients suffering from similar symptoms have a 74% mortality rate and only an 8% chance of a successful recovery*

14 ☐ *Concussions*

- *Generally, concussions are graded on three levels of severity.*
- *There is no physician agreement on concussion grading guidelines and return-to-play criteria.*
- *Physicians tend to use clinical experience and knowledge to make recommendations to patients.*

15 ☐ *Concussion Grading Scale*

- *There are several guidelines found in the literature, but the guideline established by the Colorado Medical Society (CMS) is commonly used.*
- *The CMS guideline, in conjunction with a physician's evaluation, is endorsed by:*
  - *American Academy of Pediatrics*
  - *American Academy of Sports Physicians*
  - *NCAA*
  - *Olympic Committee*

16 ☐ *Concussion Grading Scale*

- *Grade 1*
  - *An estimated 50-90% of concussions are classified as Grade 1 concussions*

- *Many Grade 1 concussions go unreported*
- *CMS Grade 1*
  - *Confusion without amnesia*
  - *No loss of consciousness*
  - *Remove from event pending on-site evaluation prior to return*
  - *Commonly referred to as "dinged" or "bell rung"*

17 Concussion Grading Scale

- **Grade 2**
  - *CMS Grade 2*
    - *Confusion with amnesia*
    - *No loss of consciousness*
    - *Remove from event and disallow return*
    - *Monitor signs and symptoms over 24-hour period*

18 Concussion Grading Scale

- **Grade 3**
  - *CMS Grade 3*
    - *Loss of consciousness*
    - *Remove from competition and transport to appropriate medical facility*
    - *Thorough neurological exam*
      - *CT scan*
      - *MRI*
    - *Monitor until symptoms subside*

19 Return-to-Play Criteria

- **Signs and symptoms should not recur with exercise or physical exertion**
- **No universal agreement on guidelines**
- **Guidelines should be used in conjunction with a physician's clinical findings**
- **Return-to-play criteria were developed by CMS to accompany the concussion grading scale**

20 Return-to-Play Criteria

- **Grade 1**
  - *Remove from competition*
  - *Examine immediately and every 5 minutes for the development of amnesia or post-concussion symptoms at rest or exertion*
  - *Athlete may return to competition if amnesia or other symptoms do not appear after a 20-minute observation period*

21 Return-to-Play Criteria

- **Grade 2**
  - *Remove from contest and disallow return to competition*
  - *Examine frequently for evolving signs and symptoms*
  - *Re-examine the next day*
  - *May return to practice after one full week without symptoms*

22 Return-to-Play Criteria

- *Grade 3*
  - *Transport from field by ambulance (with cervical spine immobilization, if indicated) to nearest hospital*
  - *Thorough neurological exam*
  - *Hospital confinement if indicated by signs and symptoms*
  - *If findings are normal, instructions to family for overnight observation*
  - *May return to practice after two full weeks without symptoms*

23 ## *Return-to-Play Criteria*

- *Guidelines differ if an athlete suffers multiple concussions of any grade in one season. A physician should be consulted for recommendations*

24 ## *Head Injuries in Football*

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- *Maintaining proper equipment fit is extremely important in preventing catastrophic injuries in football*
- *The football helmet and mouthguard are extremely important in preventing concussions*

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1 - *Certified for safety by the NOCSEA*
- *Seven general criteria for the proper fitting of football helmets.*

2 - *Criteria assessment:*
  - *spacing above eye brows*
  - *face mask clearance*
  - *chinstrap*
  - *jaw pads*

- *ear holes*
- *coverage of the back of the head*
- *no helmet movement front to back*

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- *Wisconsin high school football helmets*
  - *1671 helmets assessed for proper fit*
  - *3403 fitting errors were found*
  - *62% had multiple fitting errors*
  - *Only 15.4% of helmets were fitted properly*
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    - *air in airbladders*
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- *Every helmet comes with specific fitting guidelines and instructions particular for that helmet*
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- *Although helmets can help prevent many head injuries, the warning label on helmets states no helmet can prevent all such injuries.*
- *Warning labels contain the following information:*
  - *Do not strike an opponent with any part of this helmet or face mask.*
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- *Most commonly used piece of protective equipment*
- *Protect against injuries to teeth, gums, jaw fractures, face lacerations, and head injuries, including concussions and neck injuries, through shock absorption*
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1 ☐
- *Should be comfortable, made of durable light materials, and not interfere with breathing*
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  - *pre-molded*
  - *boil and bite*
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- *General fit criteria*
  - *cover upper teeth to back surface of second molars*
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- *properly extends above the gum line*

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- *All paper work should be completed.*
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- *The National Youth Sports Safety Foundation (NYSSF) found various barriers in implementing injury prevention in youth football*
  - *misinformation*
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36 ☐ *Conclusion*

- *Traumatic outcome of head injuries can be prevented through proper equipment use and assessment of injuries.*
- *There is a need for increasing education of players, parents, and coaches regarding prevention of head injuries in football.*

37 ☐ *Thank You !!!*

38 ☐ *Questions??*

Concussions In Football

By
Colleen Chalini, A.T.,C.
University of California, Davis, B.S.
San Jose State University, Graduate Student

...tline

- Introduction
- Concussions
- Post-Concussion Syndrome
- Second Impact Syndrome
- Concussion Grading Scale
- Return-to-Play Criteria
- Concussions in Football
- Football Helmets
- Mouthguards
- Conclusion

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- There are a number of different diagnoses associated with head injuries, including concussions.
- Coverage of high school football games by physicians and athletic trainers is not uniform.
- Athletes, coaches, administrators and parents need to take the necessary steps when an athlete has sustained a concussion.

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- Parents
  - Interact with athletes on a daily basis
  - Familiar with functional capacities
  - Responsible for athlete's health
- Best defense against traumatic outcome from concussions is prevention
  - Helmets
  - Mouthguards
  - Concussion Education

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- Concussions are a condition usually resulting from a violent jar or shock, resulting in immediate and transient impairment of neural function and the brain's ability to function properly
- Concussions can cause a swelling in the brain resulting in problems with:
  - coordination
  - balance
  - posture

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- Unsteadiness
- Headache
- Dizziness
- Disorientation
- Unequal pupils
- Amnesia
- Loss of consciousness
- Ringing in the ears
- Personality changes

st-Traumatic Syndrome

- Decrease in processing speed
- Symptoms last longer than expected
  - continuous headaches, poor concentration, mood changes, fatigue
  - can take 35 days or more to recover
- An MRI or CT scan may be indicated
- Activity should be monitored until signs and symptoms are completely resolved

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- SIS is rare, but can have catastrophic outcomes
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- The first few seconds after the second concussion differentiate SIS from a normal concussion

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- Initially after the second concussion the athlete appears to be dazed as if suffering from a grade 1 concussion.
- However, within a few seconds to a few minutes, the athlete will:
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- SIS is extremely rare with only 22 cases diagnosed by the National Center for Catastrophic Sports Injury Research.
- Although rare, the outcome has a 50% mortality rate and almost 100% morbidity rate
- SIS is completely <u>preventable</u> when proper protocols are followed

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- A 16-year-old suffered from a minor concussion with post-concussion syndrome.
- After 17 days, the athlete reported no further symptoms at rest or exertion.
- He was cleared to return to play 30 days after the initial injury.

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- The next game, he collided with an opponent, ran to the sidelines, and began to deteriorate on the sidelines after complaining of dizziness.
- He was treated immediately by medical staff and rushed to the hospital.
- He immediately underwent surgery for a subdural hematoma.
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- During a follow-up visit, the athlete admitted no cessation of symptoms after the first concussion.
- Other cases have been noted when athletes returned to competition too soon based on pressures to compete, not realizing the consequences of their actions.
- Other patients suffering from similar symptoms have a 74% mortality rate and only an 8% chance of a successful recovery

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- Generally, concussions are graded on three levels of severity.
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      - CT scan
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Return-to-Play Criteria

- Signs and symptoms should not recur with exercise or physical exertion
- No universal agreement on guidelines
- Guidelines should be used in conjunction with a physician's clinical findings
- Return-to-play criteria were developed by CMS to accompany the concussion grading scale

Return-to-Play Criteria

- Grade 1
  - Remove from competition
  - Examine immediately and every 5 minutes for the development of amnesia or post-concussion symptoms at rest or exertion
  - Athlete may return to competition if amnesia or other symptoms do not appear after a 20-minute observation period

Return-to-Play Criteria

- Grade 2
  - Remove from contest and disallow return to competition
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  - May return to practice after one full week without symptoms

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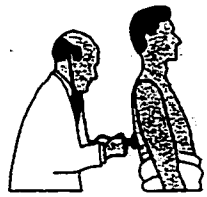

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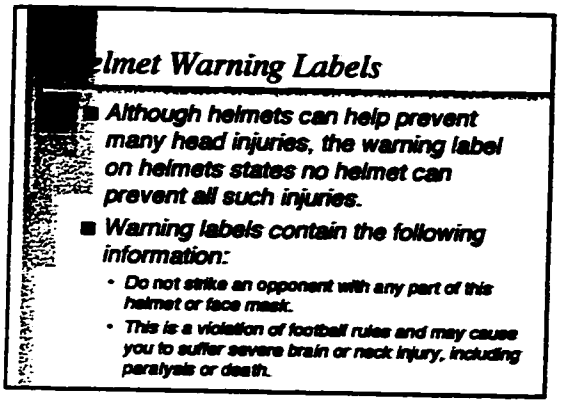
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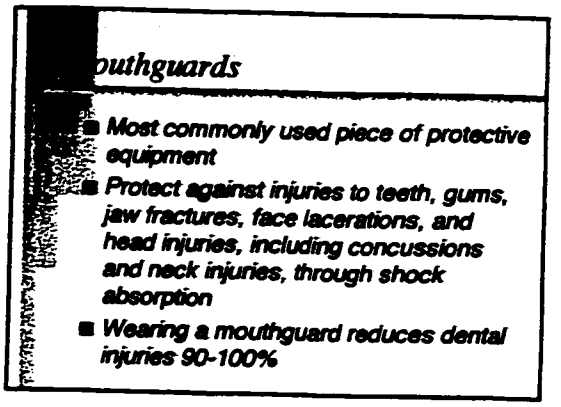
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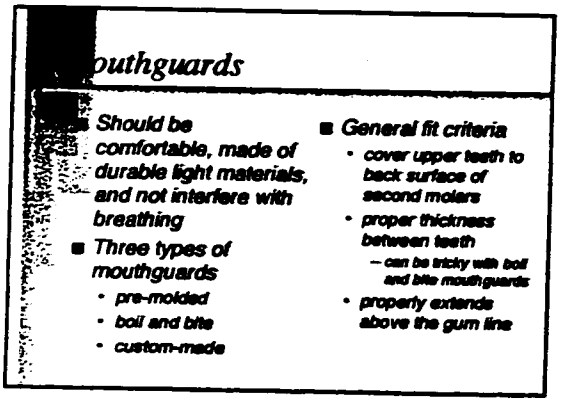
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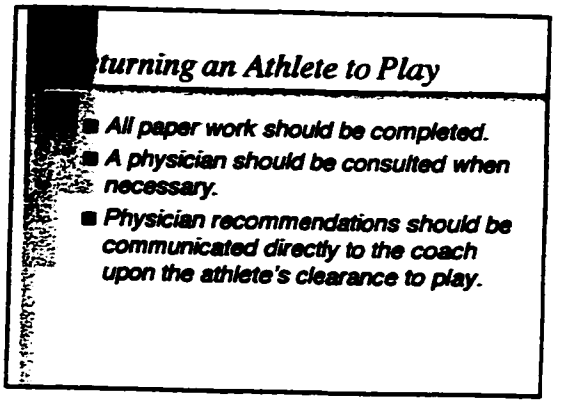
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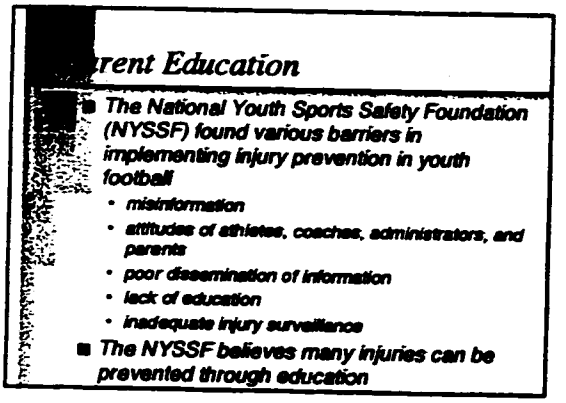
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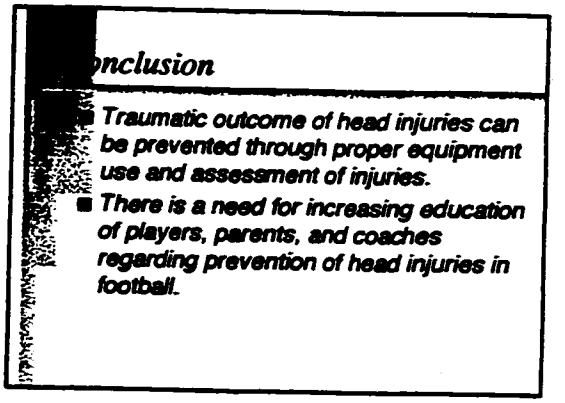
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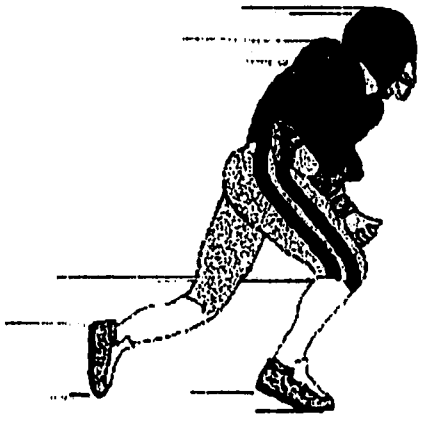

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Colleen Chelini, A.T.,C.

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San Jose State University, Graduate Student

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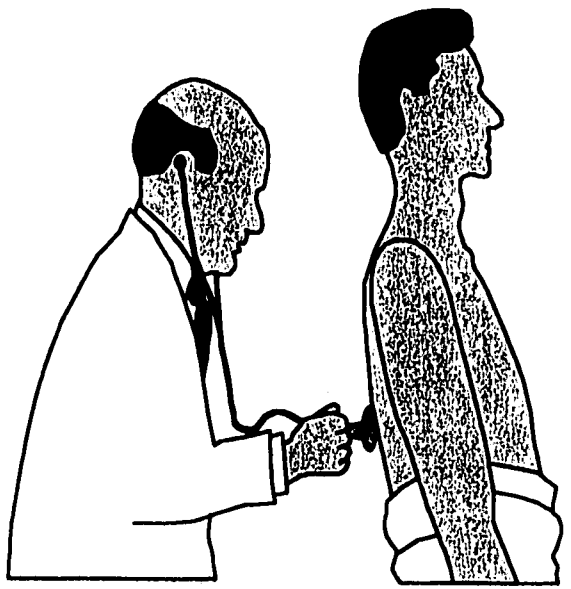

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